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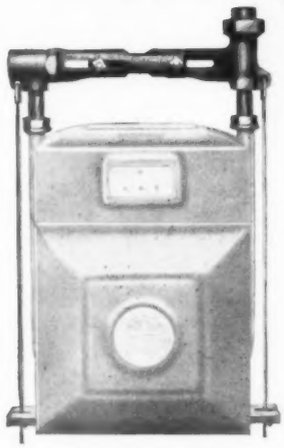

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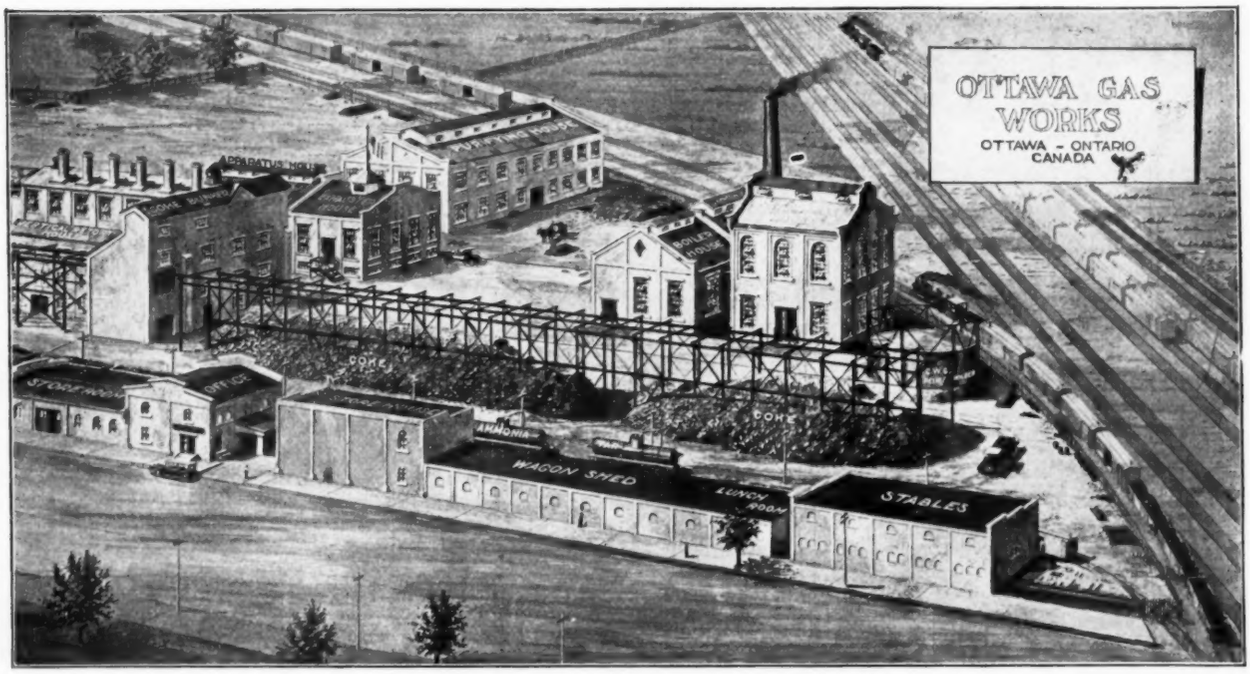

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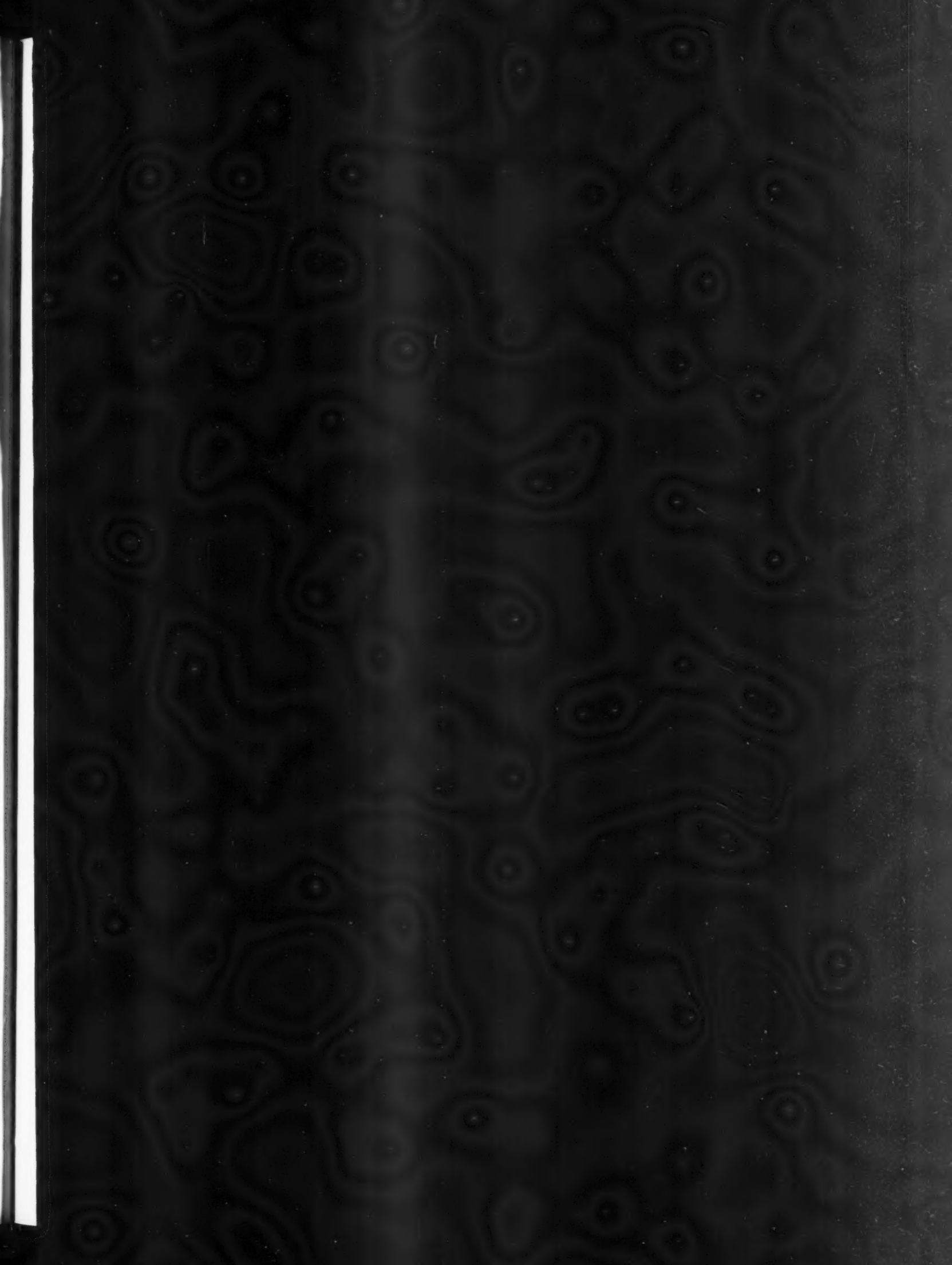

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Gas Flow Measurement

A Study of This Important Subject

By NOAH D. LAMBERT, Ch.E., M.Sc.

A gas meter is an apparatus or device which can measure the volume of gas passing through a system, in a unit or given time, or can measure the volume of a given quantity.

The word volume as here used is a contingent one, for a gas is distinguished by its property of occupying any volume. In short, it is capable of infinite expansion.

Therefore, when a volume of gas is measured, it becomes necessary to know the pressure and temperature of the gas at the time of measurement, so that the volume may be changed to its equivalent amount at standard conditions (standard conditions are 0 deg. Cent. and 760 mm. mercury in scientific research work, and 60 deg. Fahr. and 30 in. mercury in engineering work). Otherwise the volume determined has no relative or comparative meaning.

The so-called gas laws are very well known. Sometimes, very rarely though, in highly precise determinations, with gases under high pressure, the Van der Waals equation* of gases is used and the gas is passed through sulphuric acid and phosphorous pentoxide to become absolutely free of water vapor.

Gas meters may be classified in four different ways:

1. Method of showing measurement.
2. Capacity for measuring.
3. Precision.
4. Type.

1. Method of Showing Measurement

Gas meters may be indicating, recording and integrating, or any combination of these.

An indicating meter is one that shows the rate of flow, in volume units per unit of time, at any one instant.

A recording meter is one which records the rate of flow of gas on some chart for a period of time, so that the rate of flow for any instant during that interval of time can be read from the chart. The chart then forms a permanent record of the rate of flow during the interval of time.

An integrating meter shows the total volume of gas passed through the meter for any given time It is an addition or totalizing machine.

It is quite apparent that under some conditions it is preferable; in fact sometimes necessary, to have a meter measuring the flow in one way, while under other conditions another form of measuring device is essential. For example, household gas meters would be useless if they were indicating or recording. They have to be integrating. And in the case of a continuous chemical process where one or more of the substances entering is a gas and the product is dependent upon the rate of addition of the gas, then it is imperative to have an indicating meter. A recording meter can be used, too. The production of ammonia from nitrogen and hydrogen is a good example.

2. Capacity for Measuring

The capacity of a meter is the maximum amount of gas it can measure in unit time, maintaining approximately, the accuracy that it has at normal measuring capacity. The range of a meter is the rate of flow it can measure from its lowest to its highest. Beyond these limits the accuracy of the meter falls off greatly, and in many cases is totally incapable of measuring. Usually, however, the ratio of maximum to minimum flow is about ten to one. For example, in velocity meters when the rate of flow is 10 per cent of the capacity of the meter the differential pressure is only 1 per cent of the maximum. While a single meter may have a limited range, this same style of meter can usually be made in different sizes, so that any practicable range can be measured by a selection of the proper size of meter. It will be readily seen that different gas systems require different capacity meters. In some gas plants where many millions of cubic feet of gas are made daily, large station meters or other meters capable of measuring these enormous quantities are necessary. Whereas in the laboratory where certain research work requires the measure-

*The gas law $pv = RT$ is not absolutely true, under pressures higher than three atmospheres; but so nearly so, that it may be used for engineering calculations with sufficient accuracy. Actually, the molecules of the gas occupy or displace a certain definite amount of space, and the gas has inherent in itself a certain cohesion pressure. This entails a modification or correction of the above formula to account for this. In 1873, Van der Waals derived the equation

$$(p + a \div v^2)\ (v - b) = K$$

where a = cohesion pressure existent in the gas itself and b is considered as four times the volume by the molecules themselves.

ment of gases at extremely small rates and in small quantities, a totally different capacity meter is necessary.

3. Precision

A reading from any instrument is worthless unless we know what the probable error of that reading is. In other words how accurate is the determination? This applies to gas meters, too. The wide scope of uses to which a gas meter must be applied naturally contains some cases where extremely precise results are necessary, others where approximately relative results are sufficient and those that come in between. In the case of calorimetric or photometric work a very accurate measurement of the gas is necessary, while in a condition where the amount of air delivered to mines for ventilation or operation of machinery is measured, the accuracy is not of prime importance, but a qualitative determination, is. The function of the gas in the system and the purpose of the measurement in a large measure determines the accuracy of the reading required and so determines, at least in this regard, the type of meter.

Units of Flow Measurement

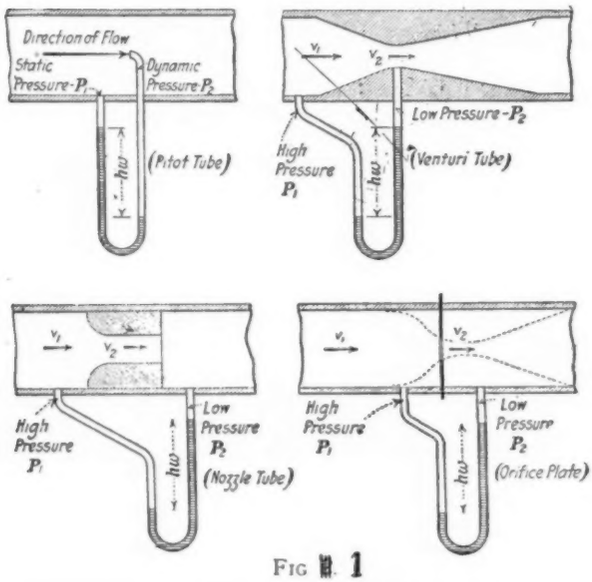


FIG. 1

4. Type

We have chosen to classify meters according to type of operation, because in a discussion of them, according to this plan, all the other features will be brought out, too.

Meters may be divided into three types: Volume, velocity, heat capacity.

Volume meters are those which function on the principle of actual voluminal displacement of a known volume of gas and as each displacement takes place a mechanism records it and the reading is given directly in cubic feet, etc.

Velocity meters are based on the principle of the gas flow laws. If there is a change in pressure between two places in a line containing a flowing gas, that change is proportional to the square of the velocity of gas flow. Since velocity times area equals quantity flow, and the cross sectional area of the pipe remains constant, we then have a means of deter-

Meter Classification

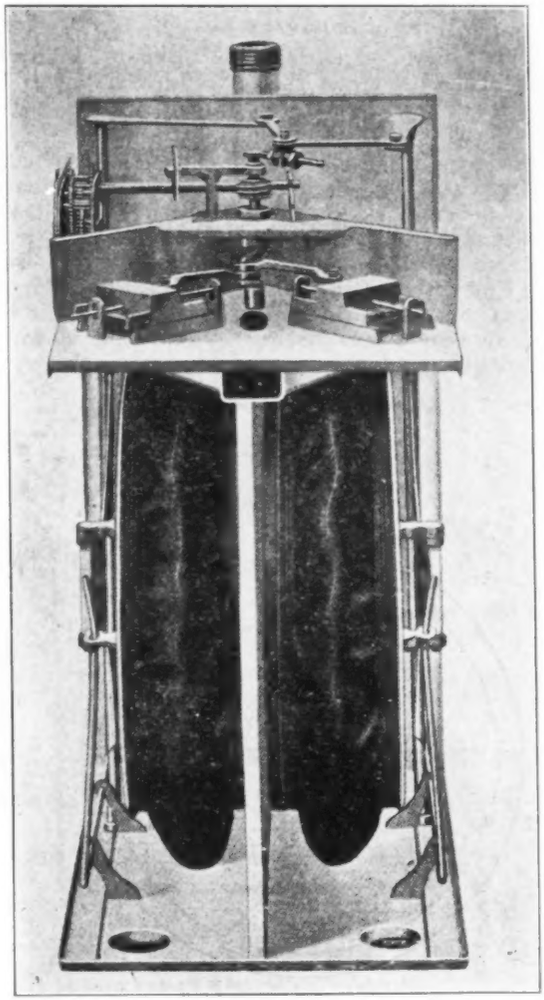
Meter	Range Cu. Ft. Per Hr.	Precision Per Cent	Type of Measurement
Volume or Displacement Meters:			
1. Dry meter	10- 17,000	½- 1	Integ.
2. Wet drum (station) meter	0- 200,000	0.5	Integ.
3. Gas holder (gasometer), cap.,	50-15,000,000	¼-10; provers-¼	Integ.
4. Steel cylinders, cap. about	180	5 -20	Integ.
5. Cubic foot bottle, cap.	1/10- 1	0.05	Integ.
6. Burettes, cap.	10- 1,900	0.10	Integ.
7. Aspirators	0- 20	1	Integ.
8. Positive blowers & exhausters	50,000- 500,000	15	Indic.
9. Proportional	25,000- 200,000	10	Integ.
Velocity Meters:			
10. Anemometer	0- 12,000	20 -30	Indic.
11. Rotary meter	1,000- 500,000	2	Integ.
12. Venturi meter	1,000- 2,000,000	1 - 5	Integ., Indic., Recor.
13. Pitot tube	9,000- 5,000,000	1 -20	Integ., Indic., Recor.
14. Orifice meter	500- 5,000,000	1 - 5	Integ., Indic., Recor.
15. Nozzle flow meter	100- 100,000	5	Integ., Indic., Recor.
16. Plug funnel meter	30,000- 100,000	2 - 5	Indic.
17a. Lambert flow meter	0- 100,000	3 - 5	Indic.
b. Variable orifice			
18. Glass flow meter	Extremely small flows	2 - 5	Indic.
19. Spitzglass flow meter	9,000- 5,000,000	2	Integ., Indic., Recor.
20. Washbottle	Extremely small flows	10	Indic.
Weight or Heat Meters:			
21. Thomas electric meter	25,000- 2,000,000	2 - 3	Integ., Indic., Recor.

Note.—The Range as cited is not the range of a single meter in each class; it refers to the range covered by all the sizes of a single kind of meter.

mining the rate of flow of a gas. Actually, this class of meters is constructed so that there will be a purposeful obstruction in the line, which will cause a drop in pressure. This drop of pressure is measured and calibrated in terms of cubic feet per unit of time. As a general rule, velocity type meters are more adaptable for high pressure and large quantity gas measurement, whereas volume type or displacement meters are better fitted for low pressure measurement and small quantity flow. The reason for this is that the extremely small differential of velocity meters at the lower rates of flow makes it rather difficult to secure the desired accuracy over the lower ranges.

The heat capacity meters are represented by the Thomas meter, which operates upon the principle of electrically measuring the heat required to raise the temperature of a flowing gas a constant definite amount. Approximately, it takes equal amounts of heat to raise equal volumes of different gases, equal temperature increments.

The figure illustrates the four main principles of velocity meters. As we come to the discussions of these types the principles involved will be treated also



Section of Meter Showing Diaphragm

Dry Gas Meter

When gas is sold to consumers by gas companies, the instrument that is universally used to measure the quantity sold is the familiar dry gas meter. It is called the dry meter in contradistinction to the wet type of meter because it does not contain any liquid seals in it.

Essentially, it is a tin-plate box with a horizontal partition in it about one-third of the way down from the top dividing the meter into two main compartments. The lower compartment is further divided into two divisions by an upright partition midway in position between the front and back of the meter. These divisions contain the measuring chambers. The upper compartment contains a closed in "V" shaped chamber in which the valves of the meter operate, while the outside portion of this chamber is used for the registering mechanism.

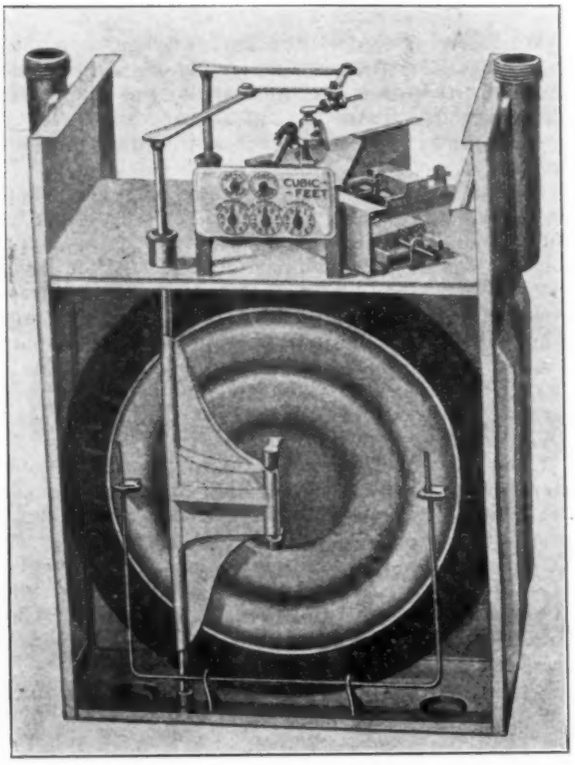
In each of the divisions of the lower main compartment there is a diaphragm which functions like a bellows and forms a gas tight chamber. The flexible part of the diaphragm is made out of leather. As these diaphragms open and close alternately because of the pressure of the gas as it enters, first into the inside of these diaphragms and then into the compartment outside of them, the registering and valve mechanism are put into motion from the motive power furnished by these alternate movements of the diaphragms. The inside connections are such that the attachments to the diaphragms operate the valves in the valve chamber causing a reciprocating motion of the valve covers over the ports and openings which control the direction of the flow of gas into and out of the diaphragms and outer sections. This movement is also transmitted to the registering mechanism which registers on the dials of the index the number of cubic feet of gas passed through the meter. This is proportional to the number of times the diaphragms expand and contract since in their extreme positions they displace inside and outside of them a fixed volume of gas.

The dry meter has been a reliable apparatus and although not as accurate as the wet meter of equal size it is much used because of durability, cheapness and service endurance without attention.

In places where the meters are exposed to the weather and extremely rough usage a Toby type is used. This type differs from the usual dry meter in that it has a cast-iron outer casing for greater protection.

Wet Drum Meters

The most accurate volume displacement meter is a wet drum meter. The principle of its operation is illustrated in Fig. 3. The meter consists of two drums—an outer drum, which is the casing, and an inner drum. The inner drum is made up of several compartments. From a side view these compartments are shaped like a helix. The gas enters the inlet pipe and passes up over the water in the small space S; from there part of it travels through (4) and part through (1) into compartment (A). Since this compartment is sealed with water the pressure in there is the same as in the system from where the gas is coming, therefore being a little greater than in (B) this causes the inner drum which is mounted on



Section of Meter Showing Measuring Device

a shaft to rotate; and when each compartment leaves the water the gas in it gradually passes through openings like (b) and then through the gas outlet pipe. The process continues smoothly, and the revolutions of the inner drum mark the actual volumes displaced. The shaft is connected to a counting mechanism which integrates directly, after calibration, the volume of gas passed through it. The level of the water is very important and so is the temperature and pressure; consequently wet meters have thermometers, pressure gauges, and level indicators attached. Either a prover or a cubic foot bottle is used for calibrating a wet meter. The pressure difference from inlet to outlet of meter should not exceed one-half inch water pressure for small sizes, and one inch for station meter sizes. The accuracy of the meter can be maintained at ½ per cent. After 100 r.p.m. the accuracy falls off. The meter is made of tin or monel metal and in larger sizes for station meter use the outer casing is made of cast iron.

Gas Holders, Gasometers and Provers

Gas holders or gasometers, as they are sometimes called, have been for a long time, and are now even in many cases, used for measuring gas volumes. The method is obviously the most simple and direct and a good one provided the mean temperature can be determined. This is rather difficult with large holders because the temperature may vary from side to side and from top to bottom. Of course, the dimensions of the holder must be known, too, and the pressure of the gas in it determined. Small size provers built on the principle of a gas holder, are used for testing dry gas meters. They are usually of about 50 cu. ft. capacity, and can be used for testing work of any kind. Assuming ideal conditions and good instruments, the gas holder method is the most correct one.

Steel Containers and Cylinders

Steel containers and cylinders are used frequently for determining the output of compressors. Since the volume of the cylinder is constant the amount of gas inside is determined by the pressure and temperature. However, the method is likely to be inaccurate unless the temperatures are accurately known. There is no ready means of inserting a thermometer, but with accurate gauges, high pressures and a long time allowed for temperature to attain the normal air temperature, satisfactory results can be obtained. When hydrogen from steel cylinders is used to inflate dirigibles and kite balloons, this is the method used for measuring the amount.

Cubic Foot Bottle

Although this is not a gas flow measuring device, it is so closely allied to meters that it should not be omitted in this discussion.

The cubic foot bottle is the ultimate standard by which small size meters are accurately standardized, and it is the one which the Bureau of Standards uses as a basis of comparison.

Essentially it consists of a copper flask ovoidal in shape with glass tube connections on top and bottom. These have marks on them between which at standard temperature and pressure there is a known fixed volume, usually one-tenth or one cubic foot. By filling this with gas and then displacing the volume between the two marks with water from a water reservoir above and then passing the gas displaced through

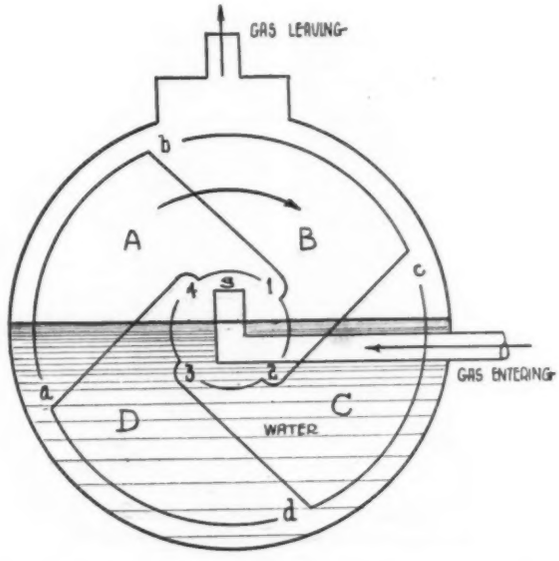


FIG. 3
DIAGRAMATIC SKETCH OF WET DRUM METER.

the meter to be calibrated we can then determine the precision of the meter. Several tests are made and the average is the result used.

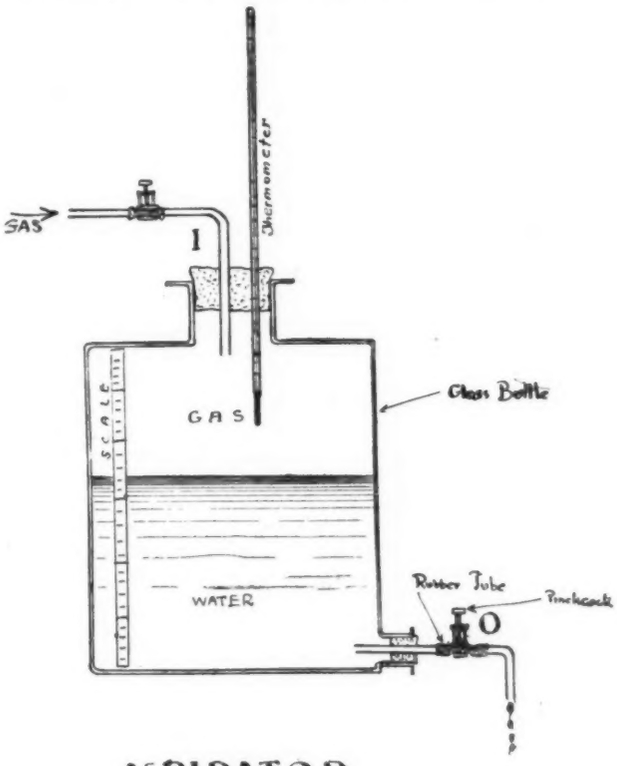
Cubic foot bottles are made very carefully and elaborately, sometimes so that very delicate adjustments of every variable can be made.

Burettes

Burettes are largely used for experimental work. They are fundamentally, carefully graduated glass tubes with connecting stopcocks and leveling bottles. When a volume of gas is to be measured it is taken into the burette over water or some other liquid, and then the leveling bottle is brought up to such a height that the liquid level in both the bottle and the burette are alike, insuring that the pressure of the gas in the burette is equal to atmospheric pressure. The level of the liquid is read on the graduations and from this the volume of the gas in the burette is determined. Burettes in connection with additional apparatus are used considerably in gas analytic work because they are very accurate when using small volumes.

Aspirators

An aspirator in its simplest form is a glass bottle as shown in Fig. 4 with an outlet at the bottom. It contains water and as the water is drawn off through the bottom (O), the gas, connected on any gas system is drawn in through the top (I). It offers a very simple way of getting a uniform sample of gas over any length of time simply by regulating the pinchcock (O). The accuracy of an aspirator for measuring gas is a matter of convenience. If necessary it can be carefully graduated and with the aid of a thermometer and a manometer can be made a rather accurate apparatus.



ASPIRATOR

FIG. 4

Positive Blowers, Exhausters and Compressors

Positive blowers, exhausters and compressors can be used easily for roughly metering large quantities of gases, provided that they have been calibrated under the same conditions that they are going to be used for measuring. There are three variables which determine the quantity displaced; inlet pressure, outlet pressure, and speed of blower. With any two of these variables fixed the varying of the third is proportional to the quantity of gas flow.

Proportional Meter

A proportional meter is just what its name implies. For large rates of flow and where accuracy is not of prime importance and cost of meter and size of meter per capacity of flow is a factor, then a proportional meter is suitable. It works on the principle of a definite proportion of the total flow of gas being bypassed through a small meter which is already calibrated to read directly in terms of the total flow. The proportional meter consists of a main or proportional casing and the small meter as a tally. Any small meter can be used if properly calibrated. Corrections for pressure, temperature and density have to be made. An error in the small meter is, of course, magnified as many times on the total rate of flow as the total rate of flow is to the amount passing through the tally meter. Usually the size of the tally meter is such that it passes from ½ to 6 per cent of the total gas flowing.

Anemometer

An anemometer is essentially a shaft with blades or vanes attached to it in such a way that when properly put in a stream of flowing gas the impact or velocity head of the flowing gas will cause the vanes to revolve and the revolutions then are indicated by a gearing arrangement to read in velocity units. It is not a reliable instrument except perhaps in wind measurements for aeronautic or marine work. They are very delicate and indicate differently at repeated times. Besides in a pipe the velocity is not the same at all points in the cross-section. They have to be carefully calibrated, of course.

Rotary Meter

The rotary meter is an elaboration and magnification of the anemometer principle. But it is much more reliable and is built to measure vastly greater gas flows. See Fig. 5.

Essentially it consists of a series of vanes in turbine wheel fashion, set at an angle of about 45 deg. A vertical shaft passes through the center of the wheel with jeweled bearings at top and bottom to reduce friction to a minimum. The revolutions of this shaft

(*Continued on page* 105.)

Customers Petition for Rate Increase

City Authorities Also Join in Asking for Raise

Recently the Dome Gas Company, of Sullivan, Ind., came before the Indiana Public Service Commission with an unusual petition for an increase in rates. Along with the company's petition to the commission was filed an agreement entered into by city authorities and 419 out of 425 consumers of the company's product. A paragraph of the order under which the commission granted the increase shows what can be done in such a community by a bit of well-thought-out co-operative effort on the part of everybody.

"In authorizing the rates agreed on," said the commission's order, "the commission cannot but congratulate petitioner, the city officials and the consumers of natural gas in Sullivan for the broad-minded spirit in which all parties to this question have realized the necessity of some method of conserving the limited and failing supply of natural gas in this community."

That the city authorities and consumers can be taught the value of service is shown by the accompanying article. And the result was immediately forthcoming. To the Dome Gas Company we say: "Atta boy!"—Editor.

The weekly news bulletin of the Indiana Committee on Public Utility Information, realizing what an unusual set of facts was presented by the Sullivan case, sent out a half-column statement concerning it to utility men throughout Indiana, who doubtless will apply some of the pointed lessons therein to their own rate-raising problems as they occur. The Indiana committee said:

"The utility and the public at Sullivan work in perfect harmony, if the experience of the Dome Gas Company may be taken as an example. This company asked the city council to pass an ordinance approving a rate increase, before it asked the Public Service Commission to grant the increase. The Sullivan *Times* describes the case as follows:

" 'On Saturday at Indianapolis the Dome Gas Company through its attorneys, Hays & Hays, presented its application for approval of the ordinance passed by the city council increasing the gas rates of the Dome Gas Company. The commission entered an order approving the ordinance and authorizing the increase in gas rates to 60 cents for each thousand cubic feet used with a monthly minimum charge of $2 and a penalty of 15 per cent to be added to all bills not paid on or before the tenth of the month.

" 'In making its order the commission commented upon the public spirit of the gas company and its officers, the city officers and the consumers in general on agreeing to increase, as evidence by the petition filed by them, which petition was signed by 419 out of 425 consumers of the gas.' "

Shortly after the commission's order in this case was made public, information was received from Sullivan to the effect that a local attorney there, purporting to be representing some of the interested parties to the case, had asked the commission for a rehearing in the matter, indicating that full information had not been given by all parties interested in the case. Utility men who had seen the unusual petitions filed by the company with the Public Service Commission pointed out that a very strong fight would now have to be made by those opposing such increase if they "got anywhere" with their new move. The commission, however, has, of course, indicated that it will hold another hearing in the matter if that is necessary to satisfy everyone connected with the case.

In its order in the matter, just made public in Indiana, the commission said:

"The Dome Gas Company was authorized and directed to increase its rates for natural gas at Sullivan from 40 cents to 60 cents per thousand cubic feet, with a monthly minimum charge of $2, in accordance with an ordinance of the city of Sullivan dated May 10, 1921, amending the original franchise of November 28, 1907.

"On Feb. 5, 1921, the Dome Gas Company of Sullivan filed its petition with the commission alleging the necessity for some method of conserving the gas supply of the limited field from which petitioner draws its product. The matter was set down for hearing in Sullivan on April 30, 1921, but the hearing was postponed at the joint request of petitioner, the city attorney and attorneys for certain consumers. Subsequently, there was presented to the commission a verified copy of an ordinance passed by the city council of Sullivan, Ind., May 10, 1921, authorizing a charge of 60 cents per thousand cubic feet of gas consumed, and a monthly minimum charge of $2, which ordinance amends the original franchise granted petitioner on Nov. 28, 1907 in those two par-

ticulars. There was also filed with the commission a petition signed by practically all of the consumers, directed to the common council of the city of Sullivan, and asking that the above rates be authorized.

"Being duly advised in the premises, the commission finds that the ordinance passed by the common council should be approved, and it will be so ordered. In authorizing the rates agreed upon, the commission cannot but congratulate petitioner, the city officials and the consumers of natural gas in Sullivan for the broad-minded spirit in which all parties to this question have realized the necessity of some method of conserving the limited and failing supply of natural gas in this community. It is apparent that this community realizes the benefits of the natural gas service, and the importance of conserving that natural commodity.

"It is therefore ordered by the Public Service Commission of Indiana, that the ordinance protecting the supply of natural gas in the city of Sullivan, and establishing the rate that petitioner may charge its consumers for gas furnished them, and amending an ordinance granting the franchise by the city of Sullivan to the predecessor of petitioner be, and it is, hereby approved.

"It is further ordered, that the Dome Gas Company be, and it is, hereby authorized to charge and collect the following schedule of rates on consumption after May 25, 1921:

Consumption Per Month	Per 1,000 Cu. Ft.
For all gas consumed	$0.60
Monthly minimum charge	2.00

"There shall be added to all bills not paid on or before the tenth of the month following service a penalty of 15 per cent, and service may be discontinued upon the failure of any consumer to pay any and all bills for gas or other service rendered on or before the tenth of the month succeeding the month in which service is rendered.

"It is further ordered, that the Dome Gas Company, on or before June 1, 1921, shall file with the tariff department of this commission, and shall post and keep posted in its office in full view of the public during the entire period such schedule is in effect, a printed or typewritten copy of such schedule of rates, as required by sections 41-47 of the public service commission act.

"It is further ordered, that within twenty days from the receipt of this order, the Dome Gas Company shall pay to the Treasurer of State, through the secretary of this commission, the sum of $169.03, expenses incurred by the commission in the investigation of this cause, as required by section 74 of the public service commission act."

Gas Company Representatives Gather to Promote Industry

More than 100 members of the Pacific Coast Gas Association attended the dinner held at the Multnomah Hotel at Portland, Ore., which took the place of the third get-together meeting of the body for the purpose of planning and boosting the annual convention to be held at Del Monte, Cal., September 20 to 23.

Representatives were present from Seattle, Tacoma, Aberdeen, Centralia, Salem, Portland and San Francisco. Charles A. Dickey, president of the American Meter Company, Baltimore, Md., was a guest of honor.

The principal address was made by Judge Robert G. Morrow, who spoke on the improvements the gas industry was making to keep pace with the demands of the public for labor-saving devices and along the trend of public service.

The address of welcome was made by W. M. Kapus, president of the association and Henry Bostwick, vice-president, San Francisco, extended greetings to new California members.

W. M. Henderson, secretary, outlined the program of the convention in September and urged attendance.

The visitors arrived early in the morning and were taken for a trip over the Columbia River Highway during the afternoon.

Glasgow's Remunerative Gas By-product Enterprise

Much financial gain has occurred to the Glasgow Corporation in working up, as against contracting out, by-products tar and ammonia liquors, from coal in manufactured gas.

The corporation embarked upon a scheme about two years ago when they took over chemical plant at Dalmarnock but since then the plant at all the gas works had been acquired. The initial operations were confined to crude distillation, but the results were so successful that the chemical department was able to turn over to the gas department for each ton of coal carbonized 2s. 4d. more than the average price received from contractors. Fourteen months after the inception of the department the whole of the residual products were being dealt with, amounting to 40,000 tons of tar and the equivalent of 10,000 tons of sulphate of ammonia. It was only at Provan that refining operations were carried on, and by the end of September they hoped to have there one of the best equipped chemical works in the country. The refining of the products was by far the most profitable side, and it was obvious that the corporation would benefit to the extent that they would obtain through the department the ultimate value of the tar as against the portion of the value previously received from the contractors. The department approximated more closely to private enterprise than any other department of the corporation in that it possessed no monopoly. Its products had to be sold in the open market for what they could bring. The amount of money guaranteed for tar and ammonia liquors at the beginning of the current financial year was £350,000. This sum, which would be obtained despite the fact that the bottom had fallen clean out of these markets, was about £60,000 more than last year, and £150,000 more than was received for the year 1919. But for the high price obtained for tar and ammonia during 1920 it would have been necessary to make a considerable increase in the price of gas.

A Duty the Gas Company Owes Its Public

How the Obligation Can Be Discharged

By J. E. BULLARD

The business man is always in danger of looking at his own problems so closely that he overlooks what the public may really be interested in. Yet if he does this his problems increase rather than decrease.

Casual observation of the gas situation in this country would lead one to believe that what the public wants is lower rates. Each and every rate reduction is given wide publicity in the newspapers and every agitation is an item of news that usually finds a place on the front pages. There are a number of cities where the city is taking a hand in increasing the difficulties of the gas company.

A look under the surface in nearly every case reveals the fact that politics have a great deal to do with the attitude of the public towards the gas company. Professional agitators are very active. They must have something upon which to work and the gas company seems to be the handiest victim. If political capital can be made of the agitation, so much the better.

Now what the people want is full value for their money. The average man is too sensible to expect to get more than his money will pay for. Accordingly it is the cue of these agitators to lead the people to believe that they are not getting a square deal. In the present state of public mind, this is often an easy thing to do.

It is not fair to the public to allow this thing to go on. It is not fair to them for the reason that if it is allowed to continue the voters may allow their representatives, the people they have elected to office, to take steps that will prove exceedingly expensive in the long run to the people of the city. In any case, they are increasing the cost to the company and thereby keeping up the gas rate when otherwise it might be possible to reduce it. Such an agitation makes it harder to get business. It tends towards a falling off in the consumption of gas. If there is not an actual falling off the send out does not increase at the rate that it otherwise would increase. All this tends towards higher rather than lower gas rates for the same price of coal, oil and labor.

The gas company owes it to itself, its stockholders and, above all, to the public itself to set people right. No individual would for a moment allow his honor to be attacked in the manner that the integrity of the gas companies have been attacked during the past year or more. No more should a corporation in which the public is so vitally interested allow such attacks if these attacks can be refuted.

Refutation is largely a matter of educating the people. One way in which to educate them is to distribute the stock more widely. If one or more shares of stock were owned in every family in the territory served, many statements now being made would not gain credence because people would know that they were not true. In addition, they would resent these statements because they would tend to reduce the value of the stock and it would be to the interest of every stockholder to keep the market price of the stock up to the maximum.

We think that all far-seeing managers will agree with the author of this article. It points out in concise fashion just what are the consequences of a passive attitude under an attack. This article might well be termed a nifty one.—Editor.

The educational value of wide distribution of stock far exceeds any other advantage that can accrue to the company by such a distribution. It would seem that it would pay gas companies at this time to turn their salesforces into company stock salesmen rather than appliance salesmen.

Then the advertising columns of all newspapers are open to the gas company for educational purposes. Only things out of the ordinary are news. Often this means that the unpleasant things are news. To get the pleasant and the good things into the paper it is often necessary to buy the space.

Every gas company can well afford to spend money in this direction. A co-operative national campaign if well conducted would more than pay for itself in the better prices for the securities that will have to be marketed during the next few years. The people don't know. They don't understand. Yet it lies with them and with them more than with the company itself whether the future securities of the company shall have a high or a low market value. A sufficient public sentiment against the gas company, a great enough ignorance of what the company is doing, and the public support that it needs will not fail to decrease the value of the securities.

The Public Loses

In the case of one company the market value of the common stock has fallen off six points as a direct result of agitation started against the company by

the members of the city council. That company is just as efficiently managed. it is just as strong financially and the gas revenue is just as great as it was before some of the aldermen started to find fault with the company. This fact, however, has not maintained the market value of the stock. That market value is going to have a good deal to do with the ease with which it can market the securities it will have to market soon in order to raise money to make additions and improvements and to meet other financial obligations. The result of an adverse market created by this agitation will be higher fixed charges due to higher interest paid for money with a consequent higher rate and also perhaps a lower return to stockholders. It is the public who are going to be the greatest losers.

The returns that a gas company can make to stockholders are limited. Savings must be given to the consumers in the form of reduced rates or improved service, for it is a generally accepted standard that in return for the protection the city and State give the gas company from competition no excessive profits can be allowed. This being the case, anything that the public does to increase the expenses of the gas company makes the gas cost more money than would otherwise be the case.

The public, however, does not know that this is the case and who can be expected to teach it these facts if the gas company does not? In a sense every gas consumer, even every taxpayer where a portion of the profits of the company are turned over to the city is a shareholder in the company. He doesn't have to own any of the company's securities to be financially interested in the company. But he doesn't know it. There seem to be a lot of people who think that the more trouble they make for the gas company the more they will benefit.

No Business Secrets

No gas company should have any business secrets that cannot be made public. If it is conducting its business in such a manner that it cannot make public everything it is doing, then those things should be change. If they are not, it may mean a prison term for someone in the not distant future and such an occurrence certainly would not do the gas business as a whole any good. Therefore, if it is known that any company is not doing business in the most efficient manner and in strict accordance with the letter and the spirit of the law and the best business ethics, every ounce of pressure should be brought to bear by every other gasman to show this company the light before it is too late.

Tell the people the facts. Tell them everything about the business. Make them see the close relation of the gas company and the public. Teach them all that can be taught them about the gas business and show them that they are really partners in the business and not merely purchasers of the service. They remember the dark past. They do not understand present conditions. It is necessary to teach them.

Take them on excursions through the plant. Have gasmen talk at every gathering where an opportunity can be found for him to talk. Let him teach the people. Use large space in the newspapers every day to tell the people the facts. Use space in the national magazines. Let no opportunity go unheeded to spread information about the gas industry and the local gas company. When this is done, it will not be long before there will be less criticism of the gas company.

Let the gas company and the gas industry sit still and never take the offensive; let the people get their education in regard to the gas business from agitators and it is going to cost the industry millions of dollars during the next decade that could be saved if the gasmen did the educating instead. The gasman owes it to himself, his industry and to the public to save this cost. The world has already seen enough destruction. Now there is urgent need of economy, efficiency and thrift. This cannot be the case in the gas business unless the public is educated. The public has too great a power in the operation of a public utility to make it at all safe to leave it in ignorance. The public must be educated.

Earnings Show Gain Over 1920

Washington, D. C.—The June report of the Washington Gas Light Company, just filed with the Public Utilities Commission, shows net earnings applicable to dividends after deducting all expenses, taxes and interest on funded debt, of $85,500.76. This report is in marked contrast with that for the month of June, 1920, on which the figures for net were written in red ink, showing a deficit of $13,261.30.

This marked change in the company's condition from the verge of bankruptcy to prosperity is accounted for largely by the fact that gas enriching oil, one of the big items of expense, has declined from around 13 cents a gallon to something less than 7 cents, while the company also has been able to effect considerable economies in the purchase of its coal supply.

For the month of June, last year, the company's operating expenses totaled $326,698.97, while for the month of June this year the total was only $261,345.88 At the same time, gross revenues for June this year exceeded gross receipts of June, 1920, by $37,114.94, due to the fact that the present rate is higher than that operative a year ago.

For the first half of the present calendar year the company's net, after all expenses and interest charges, is $165,900, as against a net for the corresponding months of 1920 of $233,930.

For the past four years the gas company in common with most other public utility companies throughout the country, has suffered severely in its net earnings, due to rising costs of operation brought on by war conditions. Now that the tide has turned and costs are on the downward scale it appears that the record for the year 1921 will be the best since 1916. During 1916 the company's net earnings were $665,083.40; in 1917 they fell to $435,792.12; in 1918 the net was only $251,190.18; in 1919, $326,917.12. Although during the latter part of 1917 the annual dividend was reduced from $624.000 to $468,000, a portion of this had to be paid out of surplus each year since 1916, due to insufficient earnings.

When Is Gasoline Not Gasoline?

An Expert Discusses This Subject with a "Journal" Representative

By J. B. DILLON

A short time since, there was a gasoline war in Denver, between several prominent dealers. The information which is shown in quotation was published as an ad and was credited to the pen of C. M. Hower, representing the Powerine Gasoline Company.

The present writer passes it along, not because of any particular brand of "gas," but because there are some interesting and instructive pointers therein.

"Breathes there a man who will not admit that the gasoline of several years ago was infinitely better than the 'ordinary' gasolines of to-day? If such there be, his legion is indeed small and his knowledge of the 'gas of yesterday' is a sadly lacking quantity.

"What, then, is the trouble with the ordinary gasolines of to-day and why are they so low in quality as compared with the old-time stuff? Contrary to what one should expect, gasoline is the one product that time and progress have not improved, due in the main, to the efforts of its makers to produce more gasoline from less crude oil.

"'To this end, all sorts of blends, formulas, 'cracking' processes and mixtures have come into practice so that the old superior and more expensive 'straight run' gasoline of yesterday is marketed only by a few companies who are more concerned about the quality of their product and the welfare of their patrons than they are about the saving of a cent or two per gallon at the expense of both the motorist and his car.

"The difference between 'straight run' and 'blended' gasoline is as decidedly marked as that between the present-day cactus-scratching 'bootleg hootch' and the smooth, mellow 'rye,' or 'bourbon,' of the days gone by.

"Blended gasoline, such as some of that now offered to the motoring public—at scrambled prices—is essentially a mixture of kerosene with 'casing-head' gasoline. While these two elements remain in a mixed condition, the 'casing-head' gasoline gives to the kerosene content the necessary volatility so that quite high gravity tests can be made while the elements remain in a mixed state, but these two elements being of a decidedly different gravity won't stay mixed any more than milk and cream will stay mixed if left standing without continual agitation. This explains your hard-to-start motor after your car has stood for a while. The kerosene settles to the bottom and since both vacuum or gravity feeds are tapped from the bottom, users of such mixtures feed pure kerosene to their carbureters prior to remixing by agitation brought about by the motion of the car. Now 'cracked' gasoline is something different again. It is a significant fact that 'cracked' gasoline is obtained from heavy oils and residues which contain no gasoline at all. A chemist might define oil cracking as the 'pyrogenetic or catalytic decomposition of complex hydro-carbons.'

"However, the average motorist will better understand that 'cracking' involves a chemical change which results in the production of a new material which is not present in the product from which it is made.

"Then, too, there are 'casing-head' gasolines which are made from natural gas by 'squeezing' or 'scrubbing' the gas with heavy oil and then distilling, and from these conglomerate compositions and decompositions various blends of 'mock motor fuel' are made and heralded to the motorists as gasoline food for motors, when they are really nothing but food for thought.

"It is a peculiar fact that no blend or mixture has yet been developed that in any way equals the good old straight run gasoline of yesterday as a motor fuel."

Mr. Hower also states that it is well that experimentation seeking to obtain more gasoline from crude oil is going on, but he, like the present writer, believes that dealers should be forced to own up that they are handling inferior stuff, so that a customer may act knowingly.

Here is a story that is pertinent to the gas industry because it has a direct bearing on our oil supply. Perhaps a close reading between the lines will tell the man who buys a lot of things. We hope so.—Editor.

Utility Rates Up to Court

Lansing, Mich.—The question of the State Utilities Commission determining utility rates where franchise rights have expired, and the municipality and the utility cannot agree on new rates, is to be settled in the Michigan Supreme Court.

Claude O. Taylor, former president of the Michigan Federation of Labor, and others have filed a petition, asking for an order to direct the Utilities Commission to establish a rate for gas lighting in Grand Rapids.

American Gas Journal

SIXTY-SECOND YEAR

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As the Journal Views It

A Weekly for Sixty-two Years

The announcement has just been made of the consolidation of the *Gas Record* with the *Gas Age*. The AMERICAN GAS JOURNAL regrets the departure of the *Gas Record* from the field. It has builded for itself a niche in the gas industry which was a credit to its publishers and a beneficial service to the entire country.

It would seem that the time is particularly fitting for the AMERICAN GAS JOURNAL to address a word to the entire industry. The first issue of the JOURNAL was published on July 1, 1859, and since that time without a break has given a weekly service to the industry. It has always been the first to give the important developments of every branch of activity in the gas industry, and has won for itself a splendid and impregnable position. When, several months ago, the AMERICAN GAS JOURNAL began devoting one issue a month to the discussion of merchandising, the move was greeted with wide acclaim. In the opinion of many of the leaders in the field it had become as nearly as possible a perfectly balanced paper, for now every branch of activity was well and fully covered. From all parts of the country have come expressions of approval and unsolicited declarations of wholehearted and loyal support. The JOURNAL has refrained from publishing any of these expressions because it felt that the public was more interested in having the work steadily progress than having us fill the pages of the JOURNAL with the expressions of approval.

To-day the AMERICAN GAS JOURNAL is a stronger factor in the upbuilding of the gas industry than ever before. But it is not content with accomplishments of the past; instead it is perfecting plans for future activities that are bound to bring it even closer to its field than heretofore, if such a thing is possible. The JOURNAL

is not published in the interests of an individual, but solely for the good of the gas industry, and it points with pride to its record and once again renews its pledge of service to the entire field.

In spite of the fact that it has been suggested many times that the gas industry did not require a weekly service, the combination of the two bi-monthly papers into a weekly has vindicated our long-sustained contention that the gas industry not only demands a weekly service but its constantly increasing support of the JOURNAL has been the best evidence that this demand was real.

It is an old saying that "Imitation is the sincerest form of flattery," and according to the announcement the *Gas Age Record* has selected Saturday as its publication date of issue, which has been the date of issue of the AMERICAN GAS JOURNAL for years.

Gas-Flow Measurement

There is no more important question in the manufacturing and distribution of gas than the measurement of it, for only in this way can the manufacturing results be checked up. The leading article of this week is a discussion of the various methods that are recognized as standard in the measurement of gas, and was not written for the purpose of comparing the different meters that are on the market. It is obvious that the author cannot enter into such a discussion because of the different conditions that exist in the various parts of the country, and because one method will apply to one section, while another could not be used.

The author of the article, Noah D. Lambert, both by training and experience is in a position to discuss comprehensively the merits of the various types of gas-flow meters.

In this period of comparatively light demand on most companies the AMERICAN GAS JOURNAL feels that its readers will welcome this discussion, for in many cases plans are now being made to take care of the unusual demand during the winter months. This will require additions to plant, and will also require new methods. We commend this particular article to the very careful attention of our readers.

A Noteworthy Achievement

The record of the Dome Gas Company, of Sullivan, Ind., should not pass without comment. Here is a company, not large, it is true, that has secured the good-will of its patrons to such an extent that when it was found necessary to apply for an increased rate it had so secured the co-operation of the local authorities and its patrons that they joined in the petition for the required relief.

This is a unique record, but it goes to show what can be done by concentrated good-will building. The JOURNAL wishes to add its word of congratulations to that of the commission that granted the increase.

Building good-will for a public utility is decidedly the work for a specialist. It cannot be done by an untrained man, nor can it be done in a hit-or-miss fashion. There are men who have made a study of this work and by their experience are fitted to win for the gas company or any other public utility the good-will and confidence of the public served. It has become almost as exact a science as any engineering work. These men know just what result will be produced by a given action or set of actions. That this is becoming more and more recognized by the field at large is shown by the fact that companies which formerly were content to allow the work to be carried on by anybody are now seeking the best talent and advice that can be secured.

One of the deterrents in connection with this work has been the generally accepted statement that building good-will was an extremely costly proposition. This has been true to a certain extent, one of the reasons being that there were men who claimed to be able to carry on this work and who proved themselves without the knowledge and training that are so essential. In addition to that, they have placed an inflated value on their services which, in the long run, would amount to nothing.

Members of the staff of the JOURNAL have been so fortunately situated during the past several years as to be able to make a study of this branch of activity. This knowledge was gained not through standing apart but through actually conceiving, carrying on and checking the results of the work done. Can there be any doubt that the JOURNAL is in a position to realize accurately the value of the work that is being done by and for the companies making up our industry?

That is the reason the JOURNAL points to the achievements of the Dome Gas Company as an example of what can be accomplished under any conditions, in any size company or in any section of the country.

Industrial Use of Gas

Artificial gas has come into wide use in industry because of its superiority as a fuel from the standpoints of uniformity, concentration, ease of control, cleanliness, lack of storage space requirements, expense of handling and financing the supply, all of which combine to make it a most desirable factory fuel.

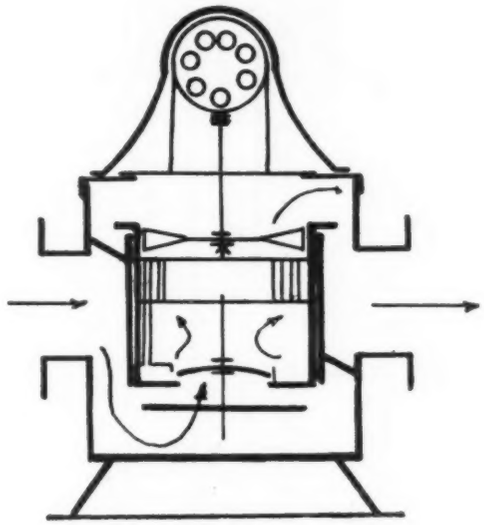
It is largely used to melt metals such as aluminum, babbitt, lead, brass, tin, zinc and linotype. Gas-fired core ovens, wherein casting molds are baked, have proven very economical. Forging work is also a large consumer of gas and porcelain enameling, brazing and japanning are other processes wherein it is widely used. Gas-fired steam boilers for plating and pressing, gas-fired lumber kilns, china kilns, coffee roasters, smoke houses and candy furnaces are also in common use. There are industrial customers in Chicago who use as high as 15,000,000 cu. ft. of gas monthly.

Gas-Flow Measurement

(*Continued from page 97.*)

are transmitted through a train of gears to the counting mechanism or dial. The gas passes in horizontally and then is diverted in an S shape direction downward and upward through a valve which prevents backward flow and directs the gas at small rates of flow. From this point the gas is broken up by a series of vertical guides and auxiliary tubes so as to be distributed equally over the vanes and thereby make them sensitive. In passing through the turbine wheel the impact of the gas on the vanes causes the wheel to revolve. These revolutions are proportional to the velocity of the gas. The meter has to be calibrated.

There are many advantages claimed for this meter. It is generally used in the same type of service as a wet station meter, and compared to it for similar capacity, it costs less and is smaller. On the other hand when impure gas is passed through it there is liability of stopping up of the vertical guide tubes. And then the turbine wheel, its shaft and bearings, are very delicate. Its accuracy is not as great as a wet station meter and to check it it must be recalibrated.



ROTARY METER

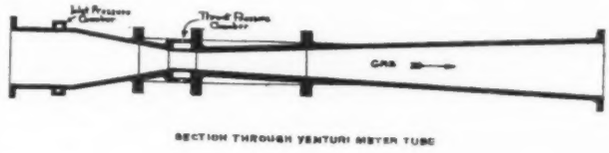
Fig. 5

The Venturi Meter

In 1796 Venturi called attention to the relation between the velocities and pressures of fluids when flowing through converging and diverging tubes.

The Venturi meter operates on the principle of Bernouilli's Theorem. It consists of a tube (see Fig. 6) in the shape of two truncated cones joined at their smaller diameters. There are two pressure chambers, one at the inlet side and the other at the throat from which points the pressures are taken. The gas flowing through the meter has the same velocity and pressure at the inlet section as exists in the gas pipe circuit in which the gas flow is being measured. But when the gas reaches the throat of the meter the velocity of the gas increases and the pressure correspondingly decreases because the cross-sectional area at that point is smaller. The quantity flow is a function of the difference in pressures between these two points.*

In the measurement of gases or air the Venturi meter occupies a special place, because there are many instances where large quantities of cheap gas or air are to be measured and on account of the comparatively small size of the Venturi meter, it is inadvisable to install the latter kind. The Venturi meter is fairly accurate when it is kept clean, but being an



SECTION THROUGH VENTURI METER TUBE

Fig. 6

inferential type of meter it has to be calibrated every time its accuracy is in question. As against the orifice meter and the pitot tube it has the advantage of

*Consider in the diagram of the Venturi meter the two sections 1 (the approach side) and 2 (the throat). The quantity flow is the same at any one time through each section.

Therefore, q (quantity flow) $= q_1 = q_2$ ..... (1)
If (a) = area of any section and v = the velocity of the gas through that section, then, $q = axv = a_1xv_1 = a_2xv_2$ ..... (2)
By transposition, $v_1 = q/a_1$ ..... (3)
$v_2 = q/a_2$ ..... (4)

Now, according to Bernouilli's Theorem, the total energy at any section is represented by the sum of the static energy plus the kinetic energy of that section, and is constant for all sections at the same time.

So, if p = pressure = static energy, and $v^2/2g$ = kinetic energy, then it follows that $p_1 + v_1^2/2g = p_2 + v_2^2/2g$ ..... (5)
from (5) .... $p_1 - p_2 = v_2^2/2g - v_1^2/2g$ ..... (6)
from (6) .... $p_1 - p_2 = (q/a_2)^2 \div 2g - (q/a_1)^2 \div 2g$ ..... (7)
from (7) .... $2g(p_1 - p_2) = q^2/a_2^2 - q^2/a_1^2$ .. (8)
from (8) .... $2ga_1^2a_2^2(p_1 - p_2) = q^2(a_1^2 - a_2^2)$ (9)
from (9) .... $q = \sqrt{2ga_1^2a_2^2(p_1 - p_2)} \div a_1^2 - a_2^2$ ..... (10)
from (10) .... $q = \sqrt{2ga_1^2a_2^2} \div a_1^2 - a_2^2 \times \sqrt{p_1 - p_2}$ ..... (11)

Since for any one Venturi meter the areas of the approach section and the throat section are constant,

then it follows from (11) that $q = k\sqrt{p_1 - p_2}$.. (12)

k in this formula is the theoretical constant; in practice another constant (c) must be put in to represent the efficiency of the meter under definite conditions.

Hence, $q = kc\sqrt{p_1 - p_2} = K\sqrt{p_1 - p_2}$..... (13)

giving a much larger differential pressure, the drop being 20 in. to 2 in. (water pressure). The size of the tube is the same as the size of the pipe line in which it is installed, and may be as high as 60 in. in diameter. The manometer is usually a recording instrument which gives the volume and flow readings directly. It should be remembered carefully that this meter or, in fact, any inferential meter is accurate only when it is calibrated under the same conditions as it is used.

Pitot Tube

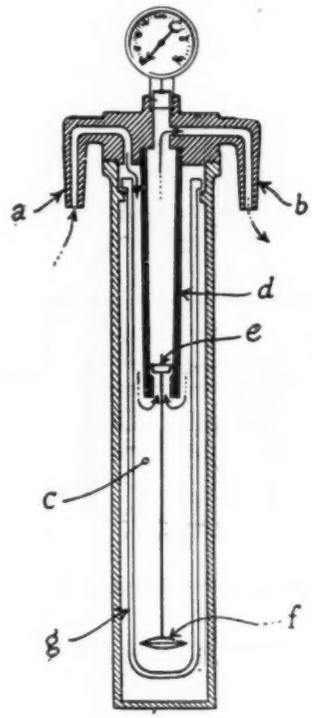
The pitot tube is a very familiar fluid measuring device and much has been written about it. The principle of the apparatus is shown in Fig. 1. There are two small tubes from two legs of a manometer connected into the pipe carrying the flow of gas. One of the openings of the tubes faces against the direction of flow while the other either faces the opposite direction or, does not protrude into the pipe. The first mentioned tube has the flowing gas impinged against it and so a pressure is set up in it. This pressure equals the static pressure plus the velocity pressure. The other tube has only the static pressure upon it. The difference recorded in the manometer is a function of the quantity of gas flowing. There are many variations in shapes and forms of pitot tubes manufactured, but essentially they are all alike. For small velocities pitot tubes are inaccurate because the velocity head is then small. Where the flowing gas contains particles of dirt pitot tubes are inadequate because they become readily stopped up. Generally pitot tubes may be used in systems in which the piping is 3 in. or more in diameter. For natural gas measurement at high pressures and in similar cases pitot tubes are very adaptable. Unless properly used they may be 10 to 20 per cent in error. With special precautions an accuracy of 1 per cent may be consistently obtained. The main point to be observed is the position of the tube in the pipe, for the velocity of the gas in the pipe varies across the section and is greatest at the center. Metering devices for indicating recording and integrating the flow of gas are manufactured with pitot tubes also.

Orifice Meters

The principle of an orifice meter is illustrated in Fig. 1. A disc or plate with a carefully-made opening, usually round, is placed transversely in the gas conduit and a manometer attached in such a way that one leg of it is on one side of the orifice plate and the other leg on the other side. The gas in passing through the orifice has to contract and in doing so its velocity there is increased with a resultant decrease of pressure at that point. The difference in pressure can be expressed mathematically as a function of the velocity or quantity flow of gas. The plane of narrowest contraction of the stream is termed the "vena contracta," and for the greatest pressure difference one leg of the manometer should be connected at that place. But with different fittings and different orifices that section occurs in different places. The manometer can be a recording one so that the gas flow can be read directly. Here again as in the pitot tube the differential for a considerable gas flow is very small and therefore limits the possible accuracy of the meter because of the difficulty of reading small pressure differences. To increase the differential and so make the reading more precise and significant the relative size of the orifice can be made smaller, but this entails back pressure in the system, which is undesirable.

A necessary precaution in the use of a calibrated orifice is, that it must be used under precisely the same condition that it was calibrated under or vice-versa, which means that the place and method of installation in the system are very important considerations. An orifice meter should be accurately calibrated for many velocities in its range, and each size of orifice should be calibrated, because the "coefficient of efflux" or constant K in the theoretical equation of flow varies somewhat with these conditions.

This means that an orifice meter can be a fairly reliable meter provided it is used where the flow of gas continues with small variations under fairly constant conditions, i.e., the orifice meter serves best as a control agent.

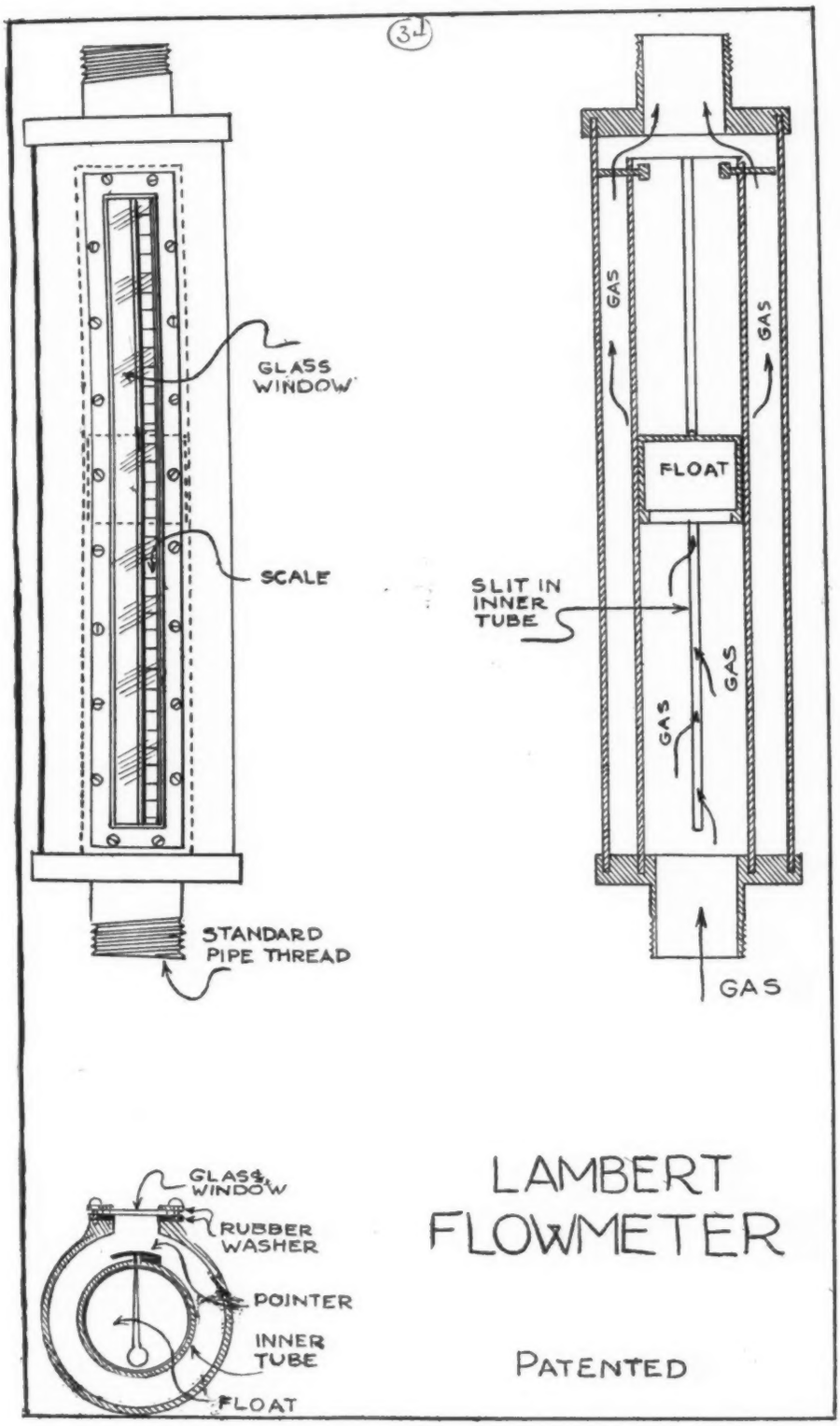


Variable Orifice Flowmeter

An orifice meter is in a class with large volume measuring meters and can be used in high-pressure systems, too.

The Flow Nozzle

Here again we have an inferential type of meter which is a slight variation from the orifice meter. It consists of a metal nozzle or funnel placed between two flanges of a pipe. The sketch in Fig. 1 illustrates the principle of operation of the flow nozzle. The flow of gas produces a reduction in pressure at the throat of the flow nozzle, therefore the pressure under the flow nozzle will equal the static pressure minus the velocity pressure, while the pressure un-


GLASS WINDOW
SCALE
STANDARD PIPE THREAD
GAS
GAS
FLOAT
SLIT IN INNER TUBE
GAS
GAS
GAS
GLASS WINDOW
RUBBER WASHER
POINTER
INNER TUBE
FLOAT
LAMBERT FLOWMETER
PATENTED

der the inlet side equals the static pressure. The differential pressure then is proportional to the rate of flow. Like the orifice meter, it produces a slight back pressure on the line. A recording manometer which gives the readings directly is usually used with this meter. These nozzles are adapted to pipes larger than 2 in. and up to about 14 in. in diameter. While they lessen somewhat the eddy currents which are incident to orifice meters they are not quite as accurate or reliable. This is another meter which should be used in such cases where the total air to any department of an industrial plant, the air to mines, the flow of natural gas, output of producers, or the amount consumed by engines, furnaces, etc., is to be measured.

Funnel Meter (Flow Prover)

There are cases where large meters already installed have to be tested and no conveniently available means present themselves. In such instances a funnel plug meter can be used. It is a very simple device consisting of a funnel as in the sketch, the small end of which is the inlet and it fits into the line and the large end, the outlet, is closed in with a plate which has a number of holes. During a test these holes or orifices are plugged with rubber stoppers leaving just that combination of holes open which will give a pressure difference equal to that pressure at which the funnel meter was calibrated. Since each hole was calibrated and tested to pass a certain number of cubic feet of gas per hour at a definite pressure difference, the total rate of flow is the sum of the flow through the open orifices.

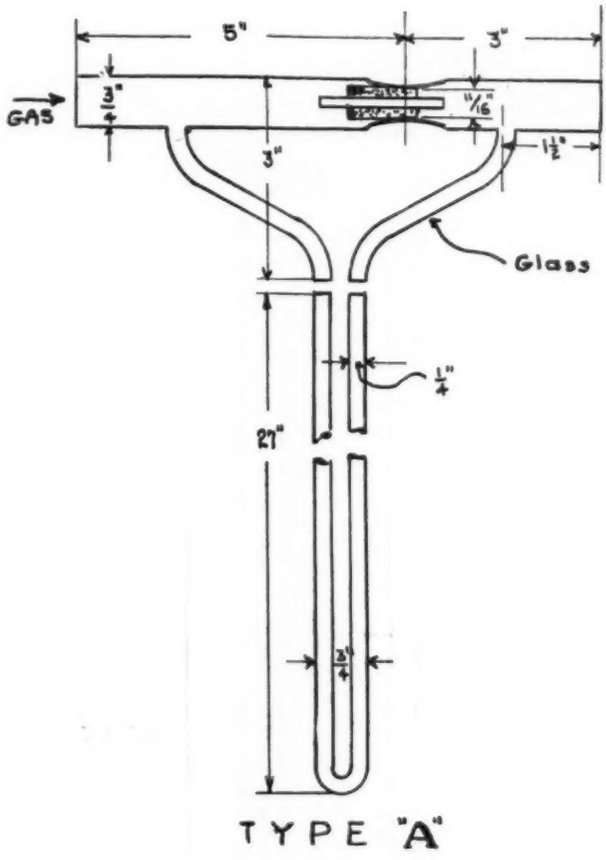
These are adaptable for low pressure testing, say, 4 in. — H_2O pressure.

Lambert Flowmeter

The Lambert Flowmeter is an indicating meter of the variable orifice velocity type. This type of meter unlike the usual velocity type, maintains a constant difference of pressure for a variable velocity and varies the constriction or orifice. The drawing shows two views and a cross section of this flowmeter. It consists of two tubes, one within the other, and inside of the smaller tube, which is of the same diameter as the gas pipe containing the flowing gas to be measured, is an aluminum float shaped like a piston. This float has a pointer attached to it which projects through a long, narrow, slit that forms the variable orifice in the inner tube and points to a scale on the outside of this tube. The outer tube has a window in it through which the pointer can be seen.

The gas enters through the bottom of the meter and lifts the float to such a height that it just balances the velocity pressure of the flowing gas. The gas then flows through the exposed part of the narrow slit into the annular space between the inner and outer tubes and then through the outlet or top of the meter. It should be noticed that the inner tube does not extend quite as far as the outer tube leaving a space and path for the gas to get from the inside of the meter through the outlet.

Since the float causes a constant drop of pressure in the flowmeter then the length of slit or orifice exposed is directly proportional to the velocity of the flowing gas.



The meter must be calibrated, of course. Its simplicity of construction makes it adaptable for the very largest capacities as well as the very smallest. Each meter has a range of about 10 to 1. In industrial processes where a gas or an air flowing is to be regulated to a definite flow, this type of meter will prove very satisfactory.

A further application of this meter is to provide a plurality of such devices which are connected and arranged to indicate the respective rates of flow of different gases comprising the constituents of gas mixtures such, for example, as nitrous oxide and oxygen for anesthesia, oxygen and air for resuscitation, acetylene or hydrogen and oxygen for welding and cutting purposes, air and ammonia gases for manufacture of nitric acid, illuminating gas and air for blow pipes, and for various other purposes where it is desirable or necessary to determine the rate of flow of gases and to enable gases to be mixed or combined in definite relative proportions.

On account of its construction it can be made out of glass in smaller sizes, and in larger sizes the metal parts can be glazed, so that corrosive gases such as chlorine and others can be measured with these meters.

Variable Orifice Flowmeter

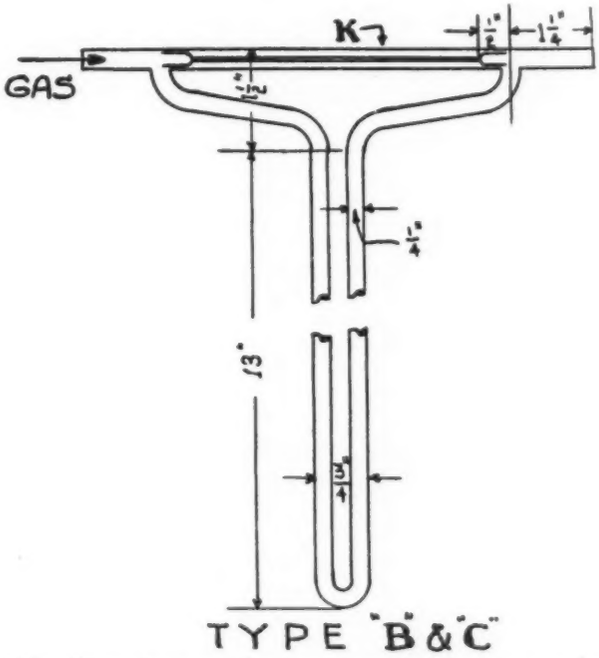
Another type of variable orifice flowmeter is shown in the sketch. It consists primarily of a tapered tube (d) with a float (e). As the gas flows from (a) to chamber (c) and then through (d) and out of (b) the float rises in proportion to the velocity of the flowing gas and thereby increases the size of the annular orifice around plunger (e). The gas flow is

indicated by pointer (f) which moves alongside a calibrated scale; (g) is a glass tube. This flowmeter is necessarily restricted to small flows and sizes, and for qualitative work it can be adapted because of its probable small cost. Binding of the float is apt to occur.

Glass Flowmeters

For purpose sof measuring extremely small rates of gas flow and especially when the gases are corrosive, a type of glass flowmeter which can be easily constructed and made in quantity, has been developed by the Research Division of the Gas Warfare Department.*

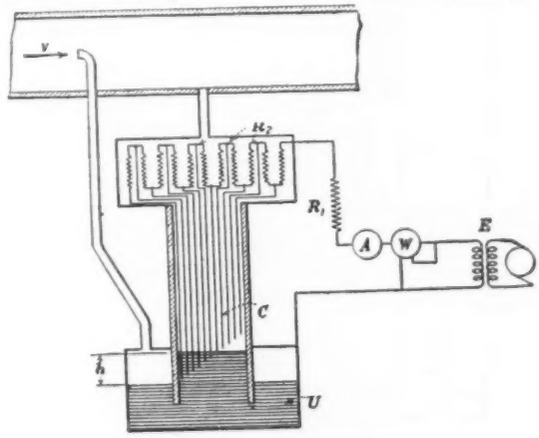
The principle of the meter is to offer frictional resistance to the flow of gas and measure the pressure drop acros sthe contracted section. These pressure drops are calibrated with a wet test meter to read in liters per minute. Three types have been developed to cover a wide range of flows. Type A. shown in the drawing, is for 1 to 300 liters per minute. In the constriction there is placed a one-hole rubber stopper through which passes a short glass tube of suitable size to serve as the resistance. Manometer is either sealed in or connected with rubber tubing. Type B and type C are essentially the same(shown in drawing). They are made to measure from the smallest possible rates to about five liters per minute. The capillary tube K in type B is sealed in, whereas in type C for extremely small flows the tube is connected with rubber tubing. Each meter, then, is made with a set of replaceable capillary tubes of suitable dimensions so that any particular rate can be readily obtained. The manometer tube is filled with water or oil, but the same fluid should be used for measuring as for calibration. Elaborations of the elementary design have been made to faciliitate filling the manometer tubes, reading the levels, etc.



*Gas Flowmeters for Small Rates of Flow.—A. F. Benton, J. I., E. Ch., July, 1919.

Electric Flowmeter

A very ingenious device for measuring by means of an electric current the flow of gases was invented by J. M. Spitsglass. Briefly stated, it is an electric manometer which measures the differential pressure of the flow across any style velocity meter. The essential features of the meter are shown in the diagram. The flow in the pipe is represented by the difference in mercury levels of the U tube connected to the pitot tube. There is a constant electromotive force (E) (40 volts), a fixed resistance (R), a variable internal resistance (R), an ammeter (A) and watt-hour meter (W). The low-pressure side of the U tube forms the constant chamber (C) in which there are a number of conductors of varying length. These conductors connect with variable resistances which correspond to the varying length of the conductors. As the mercury level rises it makes contact with one conductor after another. The current passing through the circuit, therefore (mercury is part of the circuit), varies with the rise and fall of the mercury column. The meters are designed to vary the current from 0.1 to 1 ampere. The range in flow measurement is unlimited but in the case of an individual meter its range is 10 to 1. The meters can be indicating, integrating and recording.



Electric Flowmeter

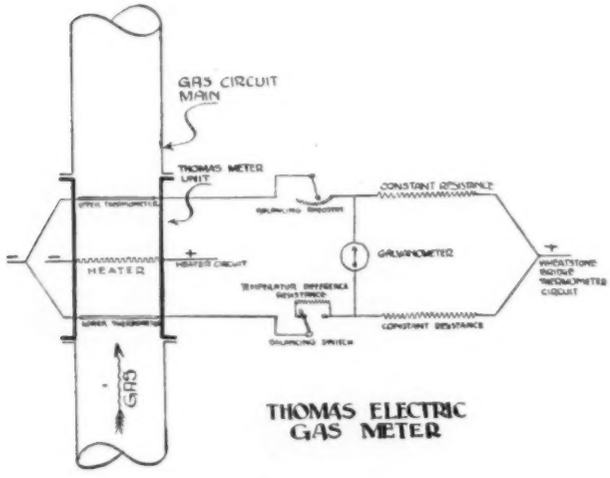
A word should be said about the accuracy of the meter since this point is one of the strongest arguments put forward for it. The efficiency of velocity meters do not contain any moving parts. But it is in the measuring parts that the possibility of error sets in because of the moving parts especially after some use. Electric measuring devices are, of course, much more sensitive and compliant with conditions. They can be easily checked in place.

Wash Bottles

A very crude and qualitative sort of flowmeter for very small flows of gases is an ordinary wash bottle as shown in the sketch. By watching the bubbles of gas as they stream through the water a relative idea of the rate of flow is gotten. This idea is sometimes used on anesthetometers where the flow of ether to the patient is regulated.

The Thomas Meter

Although the Thomas meter is a recent addition to the long list of gas meters now in use, it has already intrenched itself with considerable success in those industries where gases are measured in large quantities. Of all the meters it is the most marked



THOMAS ELECTRIC GAS METER

in that it departs most widely if not completely from any of the principles of gas flow measurement. It is not a variation of any other type of meter; it represents a totally new idea.

Briefly stated, the principle of the Thomas meter is that the heat required to raise the temperature of equal volumes of gases under standard conditions is approximately equal for most gases. In other words, the product of specific heat by the density of gases is practically constant.

The meter itself is an ingenious device for electrically heating the gas passing through it exactly 2 deg. Fahr. and measuring the heat required to do this. Since the velocity of the gas may vary from minute to minute, the heat required will vary, too: and so the meter has as part of it an automatic current regulator which controls the current required for heating the gas.

A short pipe of a little greater diameter than the gas main has an electric heater coil in the center (see diagram) which heats the gas passing through it. Two equal resistance thermometer units as part of a Wheatstone bridge are above and below the heater unit. In series with the lower thermometer is an added "temperature difference resistance" which is just equal to the increase in resistance of the upper thermometer when it is heated 2 deg. Fahr. This causes an unbalancing of the two thermometer resistances by 2 deg. Fahr. The galvanometer of the Wheatstone bridge is so arranged that when its needle moves it starts a small motor which moves a current regulator which controls the current passing through the heater unit. The heat added is measured by a watt meter and recorded directly in cubic feet.

This meter is manufactured primarily for large gas flows. There are many points about this meter which recommend it. First, there is its comparatively small size; second, its recording and integrating features; third, it records directly in readings which do not have to be corrected for temperature or pressure. Since the heat capacity of a gas is dependent upon its mass and not its volume, it does not matter at what temperature or pressure the gas is measured. This is an important advantage. And fourth, it can be decalibrated "in situ" with accurate portable watt meters.

As against these advantages there are several disadvantages about the meter which should restrict its use to certain types of service only. While it is true that it is fairly accurate with gases that are fairly constant in composition from day to day, still in water gas practice it frequently happens that the composition of the gas may vary (especially in hydrogen content) by as much as 13.8 per cent and thi sgives an error of 1.7 per cent.† If we add to it the inherent accuracy of the meter which is within 2 per cent it makes a possible error of about 3.7 per cent. When the gas contains moisture, as is frequently encountered in practice, the error may be greatly increased due to the latent heat, of evaporation of water, which is absorbed. Although in the later forms of this meter a steam coil is usually added to preheat the gas first to evaporate the moisture. The recording and heat controlling elements consist of complicated electrical moving parts which can readily go out of order.

†Bulletin of Soc. Gas Eng., N. Y. C., Vol. II, No. 2, Nov. 15, 1920, p. 31.

Gas Company Wins Decision

Jamestown, N. Y.—The Pennsylvania Gas Company is not required to make new connections in Jamestown, under a decision handed down by appellate division, third department, of the Supreme Court sitting in Albany reversing an order of the Public Service Commission. Justices John M. Kellogg, Aaron V. S. Cochrane, Michael H. Kiley and Charles C. Van Kirk concurred in the decision and Justice John Woodward did not vote. Following the action of the commission in directing the Pennsylvania Gas Company to supply gas to four applicants from this city, the company took the case to court for a review of the order and the case has been decided in favor of the corporation.

The Citizens' Gas Committee had no connection with this particular proceeding, the matter being taken before the Public Service Commission on behalf of several private consumers who wanted connections. The commission made the order, taking the stand that cases previously decided compelled the action. The Pennsylvania Gas Company then brought certiorari proceedings, submitting the usual proof that the gas supply is insufficient. The decision reversing the Public Service Commission to the effect that the company is not required to make new connections is the result.

Saginaw Rate Advanced

Saginaw, Mich.—Saginaw's gas rate for the next ten years has been fixed by an arbitration commission at $1.25 per thousand cubic feet, with a minimum monthly charge of 75 cents. The old rate was $1.20 per thousand cubic feet, with no minimum charges. The city voluntarily increased the gas rate a year ago from 90 cents to $1.20.

Public Utilities Securities Market Report

Prices of Representative Gas Bonds

(Quotations furnished by The National City Company)

Company	Issue	Maturity	July 28, 1921 Bid	Asked
American Lt. & Trac. Co.	Five Year 6s	May 1, 1925	88	89
Brooklyn Union Gas Co.	First Consol. 5s	May 1, 1945	82	84½
Columbia Gas & Elec. Co.	First 5s	Jan. 1, 1927	82	84
Consol. Gas, Elec. Lt. & Pr. Co. of Baltimore	First Ref. 7½s	Dec. 1, 1945	97½	98¼
Consol. Gas, Elec. Lt. & Pr. Co.	General 4½s	Feb. 14, 1935	73	74½
Consol. Gas Co. of New York	Sec. Conv. 7s	Feb. 1, 1925	101½	101¾
Consol. Gas Co. of New York	One Year Sec. 8s	Dec. 1, 1921	101⅜	101½
New Amsterdam Gas Co.	First Consol. 5s	Jan. 1, 1948	64	66
Denver Gas & Elec. Co.	Gen. (now 1st) 5s	May 1, 1949	78	81
Detroit City Gas Co.	Gold 5s	Jan. 1, 1923	90	92
Equitable Illum. Gas Lt. Co. of Philadelphia	First 5s	Jan. 1, 1928	96	98
Hudson County Gas Co.	First 5s	Nov. 1, 1949	72	74
Laclede Gas Light Co.	Ref. & Ext. 5s	Apr. 1, 1934	74½	76
Louisville Gas & Elec. Co.	First & Ref. 7s	June 1, 1923	94½	96
Michigan Light Co.	First & Ref. 5s	Mar. 1, 1946	68	72
Milwaukee Gas Light Co.	First 4s	May 1, 1927	81	83
Pacific Gas & Elec. Co.	Gen. & Ref. 5s	Jan. 1, 1942	77½	78
Pacific Gas & Elec. Co.	Col. Tr. Conv. 7s	May 1, 1925	96½	98
Pacific Gas & Elec. Co.	First & Ref. 7s	Dec. 1, 1940	98	99
Cal. Gas & Elec. Corp.	Unif. & Ref. 5s	Nov. 1, 1937	84½	86
Peoples' Gas Lt. & Coke Co.	Refunding 5s	Sept. 1, 1947	72½	74
Chicago Gas Lt. & Coke Co.	First 5s	July 1, 1937	78	79
Portland Gas & Coke Co.	First & Ref. 5s	Jan. 1, 1940	75	78
Seattle Lighting Co.	Refunding 5s	Oct. 1, 1949	65	70
Southern California Gas Co.	First 6s	Nov. 1, 1950	82	86
United Gas Improvement Co.	Two Year 8s	Feb. 1, 1923	98¾	99
Utica Gas & Electric Co.	Ref. & Ext. 5s	July 1, 1957	79	81
Washington Gas Light Co.	General 5s	Nov. 1, 1960	76	77
Western States Gas & Elec. Co. of California	First & Ref. 5s	June 1, 1941	75	78

Receiver Appointed

Trenton, N. J.—Upon application of the Commercial Trust Company of Philadelphia as trustee Chancellor Walker has appointed Charles W. Hoy of Glassboro as receiver for the New Jersey Gas Company in bonds of $100,000. The company operates in sixty municipalities in Camden, Gloucester, Cumberland and Salem Counties.

In its petition the trust company asserted that the utility has defaulted in the payment of $124,187.50 on a bond issue of $2,500,000. Taxes amounting to $63,788.78, it is alleged, were due May 31 last to various municipalities in which it has real and personal property and franchises.

It was charged that the gas company has neglected to pay the interest and taxes due, and that by reason of the default the principal of the mortgage has become due and that the property described in the mortgage is becoming insufficient security for the indebtedness. On July 12 last it was pointed out that the trust company filed a bill for the foreclosure of the mortgage made by the gas company under date of June 21, 1910, to secure the bond issue, of which $1,373,000 is now outstanding.

Stock Value Increases

Beverly Gas & Electric stock sold in the public auctions at Boston, Mass., on July 20, at 225¼. The last previous sale was in January, when 221 was paid. The reduction in the cost of coal, oil, etc., recently permitted the company on July 1 to voluntarily reduce the price of gas 10 cents and electricity 1 cent. The quarterly dividend has been increased from $3 to $3.50.

Receiver for Camden Gas Co.

Trenton, N. J.—Chancellor Walker has appointed Charles W. Hoy, of Glassboro, Gloucester County, receiver for the New Jersey Gas Company, of Camden, on complaint of the Commercial Trust Company of Philadelphia that the gas company has failed to meet its taxes and interest on bonds to the amount of $2,500,000.

Appointed Trustee

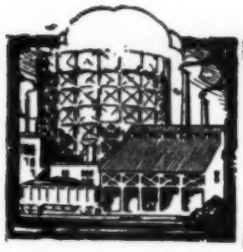
The Central Union Trust Company of New York has been appointed trustee for the Kansas Gas & Electric Company $1,500,000 general mortgage 8 per cent gold bonds, due May 1, 1941.

Company Makes Contribution

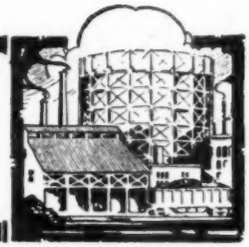
The list of contributors to the fund to defray the expenses of the recent convention of the Veterans of Foreign Wars, at Worcester, Mass., as announced by the Homer Wheaton Post, of that city, includes the Worcester Gas Light Company, which concern donated $10. The total fund was $569.

Declares Dividend

The Fall River Gas Works, Fall River, Mass., has declared a quarterly dividend of $3, payable August 1, to stockholders of record July 23.



NEWS OF THE GAS INDUSTRY



Opposes Tariff on Oil

The proposed tariff which seeks to place a duty of 35 cents a barrel on crude oil and 25 cents a barrel on fuel oil has few supporters in the business district of Worcester, Mass. The general feeling is that the proposed legislation is sectional, that it will benefit the oil producers of the Central and Southwest to the detriment of New England. Governor Channing M. Cox, of Massachusetts, wired the Massachusetts delegation in Congress asking them to oppose this question of the tariff bill and has also wired all of the State executives of New England requesting them to take similar action. DeWitt Clinton, treasurer of the Worcester Gas Light Company, believes a tariff on oil at this time would be a catastrophe. The gas company is one of the largest users of fuel oil in the city, burning from 1,500,000 to 2,000,000 gal. a year. Mr. Clinton believes a tariff on oil is practically sure to increase prices for fuel oil and gasoline and any increase in the price of fuel oil, will find reflection in increased costs of coal. Any increase in the costs of production at this time, he believes, will make the row of the New England industries much harder to hoe and they have a pretty rocky row as it is. R. W. Rollins, president of the Worcester Electric Light Company, believes a duty on oil will work a hardship on New England enterprises, at a time when they need assistance.

Voluntary Reductions in Gas Rates

Oklahoma City, Okla.—The Wynona Gas Company, of Wynona, Osage County, has asked permission of the Corporation Commission to reduce its rates for domestic gas from 60 cents per thousand cubic feet to 55 cents per thousand cubic feet. The company bases its action upon the recent order of the commission fixing a gate rate of 25 cents to the Quapaw Gas Company, which furnishes the Wynona Gas Company with gas at the town border.

Another public utility also voluntarily reduced its rates without being ordered by the commission to do so. The Comanche Light & Water Company of Lawton removed a 1½ per cent surcharge for electricity. The Corporation Commission authorized this surcharge several months ago when the price of gas increased at Lawton from 35 cents to 65 cents per thousand cubic feet. The Corporation Commission had previously written the Comanche Light & Power Company asking it to voluntarily remove this surcharge following the reduction in the price of fuel oil.

The action of the Lawton and Wynona companies is typical, according to members of the commission, of the spirit of co-operation demonstrated by a number of public utilities over the State that have found it possible to reduce their rates without impairing their earnings.

Gas Ordinance Passed

Lima, Ohio.—The gas franchise ordinance, as originally drafted, was passed by the Lima city council at one of the stormiest sessions on record, featured not only by hot debate, but the constant possiblity of physical clashes between partisans for and against.

The ordinance, as enacted, gives to Lima consumers a rate of 55 cents per thousand cubic feet for the first 5,000 of natural gas. It takes effect September 1. The measure was passed over the strenuous protest of the Lima Natural Gas Company and despite the recommendation of the chamber of commerce gas committee that quality and pressure provisions be eliminated and the rate left blank to be fixed by the Public Utilities Commission.

Mandamus proceedings to compel W. J. Dempster, president of council, to sign the ordinance, were ordered instituted by council after Dempster had declared, during the most heated passage of debate during the entire session, that he would not affix his signature.

Contact Club Growing

The committee on membership of the Contact Club has issued an invitation to Philadelphia Company employees to join the live organization, the objects of which are outlined in the notice as follows:

CONTACT CLUB—COMMITTEE ON MEMBERSHIP

You are invited to become a member of the Contact Club, an organization of employees of the Philadelphia Company and affiliated corporations. There are no dues. Regular meetings are planned each month and made the occasion for a simple informal dinner.

The principal objects of the Contact Club are—

To develop skill in public speaking, so that we may be able to defend our companies and their policies if they are criticised by the public, organized bodies or individuals.

To give opportunity for an instructive and entertaining interchange of views and information so that there will be sympathetic understanding and unity of purpose among the employees of all our companies.

To create more pleasant personal relations, cordial and hearty co-operation between departments and companies, and a genuine feeling of good fellowship.

The Contact Club is now conducting meetings in two sections, Tuesday and Friday of each week, the members giving short speeches and receiving suggestions and help from Prof. Sleeth, a well-known public speaking instructor. A great deal of interest is being shown in the meetings by members interested in the welfare of the company as well as their own.

Cannot Tax Gas Meters

Kingston, N. Y.—A resolution passed by the common council directing the assessor to assess the gas meters of the Kingston Gas & Electric Company has been vetoed by Mayor Canfield on the ground that such an assessment would not be sustained.

As Mayor Canfield was of the opinion that gas meters were not assessable by local assessors he wrote to the State Tax Commission for an opinion. The commission rules that meters are not so assessable, saying in reference thereto, "You are advised that assessors would exceed their authority in assessing this class of property as such, and the common council of the city of Kingston is without authority to direct the assessors to assess such property as meters.

"The tangible personal property of individuals, partnerships and public utility corporations is the only personal property now liable to assessment for taxation purposes in this State. In the case of tangible personal property of individuals and partnerships, the assessors should denominate in the assessment roll the kind of property assessed. In the assessment of the personal property of public utility corporations, the provisions of section 12 of the tax law must be followed strictly by the assessors.

"The term 'capital stock' is interpreted to mean assets and would therefore include gas meters. In ascertaining the value of personal property of public utility corporations liable to assessment for the purpose of taxation pursuant to the provisions of section 12 of the tax law, all just debts except debts incurred in the purchase of non-taxable securities should be deducted since such debts are an offset against an assessment for personal property.

Hylan Signs Rouse Public

New York, N. Y.—Sign painters who allege they have Mayor Hylan's official permission have been painting a generous crop of signs advocating the Mayor's re-election. The signs are painted across highways in Queens County, and the taxpayers are not giving three long cheers because they are there.

Policeman Bradley, of the Long Island City Precinct, saw a man alight from an automobile at the Queensboro Bridge Plaza, unlimber a pot of white paint, and proceed to do a neat job of lettering right across the asphalted roadway almost from curb to curb. When Bradley challenged the artist, so the policeman reported, the young man displayed a permit personally signed by the Mayor authorizing the painter to beautify the thoroughfares of the borough by lettering upon them this device:

"Fight! Fight! Fight! Join the Hylan League. Fight increases in gas rates from 80 cents to $1.50; in carfares from 5 cents to 10 cents; in telephone rates of 25 per cent; in electric light rates of 27 per cent."

Bradley says he succumbed at sight of the Mayor's signature. The artist completed his job, and ere sundown he had blazoned duplicate exhortations—fifteen or twenty of them—along the Queens Boulevard, in Hillside Avenue, Jamaica; Steinway Avenue, Astoria; at the Long Island Railroad crossing of Broadway, near the Elmhurst station, and at other points where pedestrian and vehicular traffic is heavy. He was a fast but careful worker.

The lettered patches occupied spaces approximately 30 ft. square plumb in the center of the thoroughfares—city property under control of city administration. The Long Island City *Star* investigated, heard Policeman Bradley's report that the work had been done under a permit issued personally by the Mayor, and then editorially denounced the effrontery of a Mayor who could "convert asphalted boulevards into billboards for the exploitation of his political aspirations."

Channing A. Leidy, assistant to Borough President Maurice E. Connolly, the official who is supposed to have jurisdiction over thoroughfares in his bailiwick, denied that his office had issued any such permit.

Cut Gas Service Charge

Topeka, Kan.—By an order of the public utilities commission, effective from July 1, the service charge paid by customers of the Consumer's Heat, Light & Power Company in Topeka is reduced from 75 cents per month to 35 cents per month, and the money so collected must be kept in a separate fund by the company and applied to the repair of leakages in the lines.

The order of the commission reduced the rate from $1 to 50 cents per month in Atchison, and from $1 to 55 cents in Leavenworth. The 50-cent rate in force in Kansas City, Kan., remains as it was.

The order is effective for one year. At the end of that time the commission, which retains jurisdiction in the case, may make such an order as will be necessary after the relation between the cost of repairing the lines and the money collected from the service charge has been established. If the company has more money than it needs for repair work during the year the rate will be reduced or eliminated.

It is estimated that the service charge will net the Topeka company $48,000 during the year in which the order is in force.

Gas Co. Appeal to Be Heard

Petersburg, Va.—The appeal of the Petersburg Gas Company for an increase in rate will shortly be heard in the Supreme Court. The company was recently granted an appeal from the decision of the State corporation commission to allow the company to charge a maximum of $1.75 per thousand cubic feet for gas.

The company is at present charging $2 a thousand for gas and has so changed its meters and has deposited a bond to cover this overcharge with the State corporation commission.

The increase in rate was fought by the Young Business Men's Club, with Charles Hall Davis as counsel.

Gas Consumers Get $150,000 Through Court Decision

Columbus, Ohio.—The Ohio Supreme Court has handed down a decision in the case of the United Fuel Gas Company against the Ohio State Public Utilities Commission of Ohio. The court held that the commission had the jurisdiction to change the price of gas in Ironton, Ohio, in view of twenty-five years' franchise accepted by the company.

The Supreme Court granted the injunction. The decision in effect is that the State commission had no jurisdiction, having been created after the lighting contract had been made. The company asked that the franchise be declared illegal, as the rate was fixed for more than ten years. The court held that the company, having operated for twenty-two years under the agreement, could not make the change. One hundred and fifty thousand dollars will be refunded to gas consumers of Ironton.

Albany Gas Rate Dropped to $1.35

Albany, N. Y.—The price of gas in Albany has been reduced by the Municipal Gas Company, and householders who have been paying $1.50 a thousand feet will after August 20, pay only $1.35 a thousand feet. The company has made this rate for the first 25,000 ft. of gas consumed. For those who use more than 25,000 ft. a month, the price will be $1.25 a thousand and all over 50,000 ft. $1.20. The minimum charge is 75 cents per month.

Announcement of the reductions were made recently. While the reduction will affect only Albany consumers, it is likely, General Manager Carl H. Graf said, that Watervliet, Colonie and Menands would come in for reductions soon.

The new schedule of rates has been filed with the Public Service Commission.

The reason for the reduction is that the price of oil has been materially reduced. The contract price paid during the year which ends August 1 was 11¾ cents. After that date the company will pay 7 cents a gallon for oil. A contract for a year has been made, so that it is likely the reduction, effective August 20, will stand for at least a year.

The company still has on hand a supply of gas oil which will last until some time in September, Mr. Graf said.

Under a decision of Justice Charles E. Nichols made several months ago in Supreme Court, he held that the Municipal Gas Company was entitled to 6 per cent above operating expenses on its invested capital. Increases asked for at the time were fought by John J. McManus, then assistant corporation counsel and now corporation counsel, while Neile F. Towner appeared for the gas company.

Under the Nichols decision, the gas company rate was to be reduced if it brought more than a 6 per cent return, and increased if it failed to show that profit. The decision was to remain in effect until the material and labor markets regained a pre-war basis

Gasmen Accept Wage Cut

Brockton, Mass.—Employees of the Brockton Gas Light Company have accepted a 10 per cent wage cut and agreed to remain at work without a union contract, virtually an open-shop basis.

Contract Awarded

Mayor Andrew J. Peters of Boston, Mass., has awarded the contract for installing and completing electrical, gas and air systems in the Public Latin School to the Connor Electric Company, the lowest bidder, at $43,696.

No Special Investigation

An appropriation of $1,000 made by the voters of Spencer, Mass., at the annual town meeting in March, to assist in an investigation to secure lower gas and electric rates will not be used this year. The appropriation was made at the request of the Spencer chamber of commerce, as an emergency fund to be used at the discretion of the selectmen. The directors of the chamber, however, took the matter of rates up directly with the Public Utilities Commission, and after a hearing in the matter the commission sent some of its experts to Spencer to investigate and then dismissed the case against the Spencer Gas Company The directors of the chamber and the selectmen now feel that it is unnecessary to spend the money as the commission experts were in a position to determine whether Spencer was entitled to lower rates better than anyone else.

Will Reduce Rate 10 Cents

Through Attorney James A. Donovan, its counsel, the Lawrence (Mass.) Gas Company has notified Mayor William P. White of Lawrence that on August 1 a voluntary reduction of 10 cents per thousand square feet of gas and one-half cent per kilowatt of electricity will go into effect, provided the Lawrence city council abandons their plan of an investigation of the company, looking for a compulsory reduction. If the investigation is pushed, however, the reduction will not become effective, the Mayor is informed, since the company in that event will wish to reserve its resources until the report of the investigation is filed.

Votes Against Bonds

Auburn, Cal.—By a vote of 354 for and 169 against, the vote here refused to allow a $60,000 bond issue with which to purchase the water distributing system now owned and conducted by the Pacific Company. A two-thirds vote was necessary.

United Gas Improvement

Philadelphia, Pa.—The vote on the gas bill in the city council, raising the price of gas 10 cents, was 13 to 8. The price to consumers will be $1.10 instead of $1 per 1,000 cu. ft., as heretofore, and the United Gas Improvement Company will receive $1 of the gross price and the city 10 cents. Previously the company has been receiving but 75 cents and the city 25 cents.

Announces Wage Cut

Clarksburg, W. Va.—The Hope Natural Gas Company has promulgated a wage cut, effective July 1, for 3,000 of its employees in central West Virginia. Drillers will be cut from $10 to $8 per day; tool dressers, from $8 to $7; teamsters, from $9 to $8; common laborers, from 3.20 to $3, and employees of gasoline plants working eight hours, 15 per cent.

Jersey Gas Hearing Is Set

Trenton, N. J.—The public utility commission has notified the Publi Service Gas Company that a hearing on existing rates will be conducted in Newark on Aug. 3.

Gas Companies Authorized to Reduce Gas Pressure

Oklahoma City, Okla.—The Bartlesville Gas & Electric Company, at Bartlesville, and the Commonwealth Gas Company, at Wagoner, were authorized to reduce gas pressure below a 4-ounce minimum in separate identical orders issued here by the State corporation commission.

Gas Rate Increased

Charleston, W. Va.—An increase of 1 cent for each 1,000 cu. ft. of gas must be paid by domestic consumers at Weston, according to a decision by the public service commission in favor of the Keener Oil, Natural Gas & Fuel Company. The new order, effective from July 1, fixes the rate for natural gas at Weston at 29 cents. An order of the commission on Jan. 18 fixed the rate temporarily at 28 cents.

Installing Booster

Employees of the Marlboro Gas Company are installing a booster at the house on Maple Street, Marlboro, Mass. This will force more gas into the Marlboro main and assist in giving better service.

Steps Taken to Consolidate Gas Companies

Manchester, N. H.—Preliminary steps are being taken for the purpose of consolidating the Peoples Gas Light Company with the Manchester Gas Light Company, a business arrangement that has been in contemplation for a long time. The original Manchester Gas Light Company was chartered in 1850 with an authorized capital of $125,000. That amount was never issued, the capital having been increased by various votes from $60,000 at which it was originally fixed to $100,000, to which it was increased in 1853, and it has remained at that figure ever since. In 1887 the company was leased to the Peoples Gas Light Company, the old company being continued only for the purpose of receiving the income provided under the lease.

Taxation has been increased from year to year on the property until now the assessment is on $1,600,000, which the company considers excessive and its tax this year will be paid under protest, with a probable appeal to the Public Service Commission to fix the true valuation. Taken all together, the local and Government taxes amount to more than $30,000, which is the amount that the stockholders receive in dividends.

"Whether the public knows it or not, the amount paid in taxes by the gas company and every other public service corporation is and must be paid by the consumer. It has all to be figured in the rate, including a reasonable dividend for the use of the money invested," said Treasurer Africa.

The Peoples Company is having an inventory made and a valuation fixed upon all its leased property for the purpose by and by of making an application for permission to consolidate the two companies in the Peoples Company, with a capitalization in common and preferred stock commensurate with the valuation of the property. This will not come about for some months, but is one the program that is being worked out.

Refuse Gas Company's Offer

Lawrence, Mass.—Members of the city council of Lawrence have refused to accept the offer of the Lawrence Gas Company for a reduction in the net price of gas from $1.60 to $1.50 and in the price of electricity from 13 to 12½ cents per kilowatt, plus a 10 per cent discount. Each member of the council declared the proposed decrease was not enough and voted to meet again within two weeks to choose an official investigator.

Accept Wage Cut

Employees of the Brockton Gas Light Company, Brockton, Mass., have accepted a 10 per cent wage cut and agreed to remain at work without a union contract, virtually an open-shop basis.

Municipal Ownership of Gas Plant Advocated

Muscatine, Iowa.—Mayor McNutt is advocating municipal ownership of the gas plant here, following a hearing at which Dean Raymond, of Iowa City, sitting as a master in chancery, ordered the rate increased from $1.55 to $1.94 a thousand feet.

Ukiah Gas Co. Operates at Loss

Santa Rosa, Cal.—The Ukiah Gas Company, operating in Ukiah, Mendocino County, reports to the railroad commission for the year 1920 that its operating revenue was $6,427.71 and operating expenses $8,968.44, giving a net operating loss of $2,540.73. Miscellaneous non-operating revenue amounted to $80. Interest, rent and other deductions totaled $250. The net corporate loss for the year was $2,710.73. The deficit at the beginning of the year amounted to $8,441.86. Miscellaneous additions to surplus for 1920 amounted to $179.95. The accumulated deficit at the end of the year amounted to $10,972.64.

Detroit City Gas Company

Detroit, Mich.—Net earnings for the Detroit City Gas Company for May increased $83,814.32, as compared with those of April, according to a report made by the company to the city in connection with the company's justification of increased rates recently granted in part by the city. The company is a subsidiary of the American Light & Traction. Total net earnings of the company for May were $148,814.32, which figure does not include provision for depreciation, bond interest and notes or dividends.

The sale of gas by the company during May totaled 900,424,000 cu. ft., or 227,655,500 ft. less than in May of last year. This is a reduction of 20.18 per cent. The company has just completed a contract with the Semet-Solvay Company whereby the utility is to be provided with a surplus gas supply at a nominal rate.

Brooklyn Company to Make Own Gas

Brooklyn, N. Y.—Because of the high cost of illuminating gas the Doehler Die Casting Company has decided to install its own gas-manufacturing plant on its factory property at Court and Huntington Streets, Brooklyn. Last year the company's gas bill amounted to $117,000.

"Gas is an important item in our costs," said H. H. Doehler, president of the company. "Our Toledo plant gets its gas for 72 cents a thousand cubic feet, and we in Brooklyn can't compete with that rate."

The Brooklyn Union Gas Company has already announced a reduction in the price of gas from $1.50 to $1.25, to take effect on Aug. 1. The Doehler company expects to manufacture gas at a cost of 42 cents a thousand cubic feet.

Gas Rate Unpopular

Dayton, Ohio.—A petition asking the recall of the city commission at a referendum will be passed upon by the Montgomery County Board of Elections. The petition bears the signatures of 8,336 property owners, who want the present form abolished and the Federal form substituted. The petition is one of the outgrowths of dissatisfaction resulting from granting the Dayton Gas Company a sliding scale which raised the price of natural gas from 34 to 50 cents per thousand minimum and $1 per thousand maximum.

Columbia Gas Gaining

New York, N. Y.—The Columbia Gas & Electric Company reports gross earnings for the year ended June last of $14,832,179, an increase of $1,317,419 over the preceding twelve months; total income of $9,919,017, an increase of $767,682, and surplus after fixed charges and rentals of $4,758,576, an increase of $591,132 over the preceding year.

Votes to Accept Bonds

The board of aldermen of the city of Marlboro, Mass., has voted to accept the continuation bonds of the Marlboro Gas Company for $5,000.

Guffey-Gillespie Co. Absorbed by Tidewater

It has been announced that litigation pending in connection with the Guffey-Gillespie Company's affairs will probably be abandoned, as the Tidewater Oil Company interests have taken charge, the name being changed to the Tidal Osage Oil Company. Resignations were accepted from the officers, including J. F. Guffey, president; E. N. Gillespie, vice-president and director; Carrol Miller, director, and H. K. Bragdon, secretary-treasurer. The only old director to remain on the board is J. D. Callery.

In the places of the above, F. R. Fallon, Harold Butt, M. T. Williams and C. E. Hane are directors and Mr. Fallon temporary president. Mr. Williams is temporary secretary-treasurer. It is expected that the Pittsburgh offices will be closed and offices opened in New York by the Tidal Osage Oil Company, which will operate independently of the Tidewater Oil Company.

Joseph Guffey, promoter of the Guffey-Gillespie Company, and who was its president, is now in Mexico.

New Heating Company Is Incorporated

The Combined Grate & Radiator Heating Company, Knoxville, Tenn., has been incorporated by H. E. Kelly, president, and W. E. DeArmond, general Manager, with a capital of $30,000. They will manufacture radiators and general heating equipment in a plant at Fountain City, Tenn.

Heating Supply Co. Moves

The Heating Supply Company of Pittsburgh, dealers in heating equipment, including gas furnaces, have moved their offices from 421 Wood Street to Locock Street near Sandusky Street, North Side, Pittsburgh. Ira C. Ewing is manager of the company.

Industrial Conference

Governor Wm. C. Sproul, Pennsylvania, has authorized an industrial relational conference which is being arranged by Dr. C. B. Connelly, Commissioner of the Department of Labor and Industry, Commonwealth of Pennsylvania, to be held at Harrisburg, October 24 to 27. The conference is to include consideration of industrial waste, co-operation, publicity, education, women and children on industry and medical supervision of industry.

A Large Installation

The Union Gas & Electric Company, of Cincinnati, recently placed in service sixteen 91-ft. traveling water screens, the largest installation of its kind in the world. The screens are situated in an intake well 86 ft. deep and 60 ft. in diameter, in the middle of the turbine room. Water through the screens supplies 330,000 kw. turbo-generators, about 135,000 gal. water per minute being used.

Service Charge Abolished

Churchville, N. Y.—Residents of Churchville who appeared recently before the public service commission, Charles Van Voorhis, commissioner, presiding, and asked that an 80-cent service charge, authorized—they claimed by error—by Judge John A. Barhite, former commissioner, be revoked, won a decision from the commission, which handed down an order amending the former order and abolishing the charge. This leaves the village with a minimum charge of 80 cents a thousand for gas. At a recent hearing, when the matter was debated, Frank B. Barnard, of Buffalo, president of the Churchville Oil & Gas Company, stated that if the commission took the action it has taken he would "wreck the company."

Company Making Extensive Improvements

Wauseau, Ohio.—New high-pressure tanks were installed at the Napoleon plant of the Ohio Gas, Light & Coke Company recently. The pressure suffered during the installation somewhat, but at the present time the service is much better. Work on the installation of a gigantic gas holder will be started shortly, according to J. A. Sloan, who says that when this work is completed the plant at Napoleon will have a double capacity and will be able to take care of greatly increased business for years to come. The service will soon be second to none in the State.

To Increase Gas Charge

Charleston, W. Va.—Increases of from 3 to 5 cents in rates of gas furnished for industrial purposes by the Charleston-Dunbar Natural Gas Company have been agreed to by representatives of the gas company, the consumers and the Public Service Commission. It was agreed that beginning August 1 and continuing for six months the rate shall be 22 cents a thousand cubic feet for all gas used during the month for industrial purposes. A discount of 2 cents is allowed for prompt payment.

After Feb. 1, 1922, the company may increase this rate to 25 cents, provided it gives sixty days' notice and obtains the consent of all consumers of industrial gas.

Hudson Gas Co. Announces Increase

Madison, Wis.—The Railroad Commission has announced an increase in gas rates for the city of Hudson. For the first 2,000 cu. ft. of gas the new rate will be $2.45 and over 10,000 the rate will be $2.10 per thousand. The commission also increased the lighting rates at Durand and Argyle.

Edgerton Heads East Bay Company

Los Angeles, Cal.—Edwin O. Edgerton, long a recognized authority on public utility matters, and for years in the service of the public, dealing directly with corporate interests, will captain East Bay Water Company, one of northern California's most successful public service companies. At a meeting of the board of directors of the company Wigginton E. Creed, who has long been president of the East Bay organization, announced his retirement, made necessary by pressure of his multiplicity of interests, and following his resignation Mr. Edgerton was elected president. In retiring Mr. Creed stated that he was gratified to be able to hand over to his able successor an efficient organization and a corporation in good condition in every respect. He paid a tribute to his successor, under whom he felt certain the company would prosper as it had in the past. He would, he said, continue his connection with the organization, remaining on the executive committee.

Wigginton E. Creed, who succeeded Frank G. Drum as president of Pacific Gas & Electric Company, will devote his time exclusively to the affairs of that corporation.